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COMPATIBILITY OF NINTH AVENUE SUPERFUND SITE GROUND WATER WITH TWO SOIL-BENTONITE SLURRY WALL BACKFILL MIXTURES

by

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The interactions between solutes found in leachates from uncontrolled landfills and components of a soil-bentonite (SB) slurry wall are capable of causing swelling or shrinking of the SB backfill material. This type of activity alters the hydraulic conductivity of the slurry wall. The effect of solutes in contaminated ground water from the Ninth Avenue Superfund Site in Gary, IN, on the hydraulic conductivity of two SB slurry wall backfill mixtures was evaluated using rigid-wall permeameters.

Ground-water samples taken from three observation wells at the Ninth Avenue site contained solutes that could cause increases in the hydraulic conductivity of an SB slurry wall. One ground-water sample contained salt concentrations as high as 20,000 mg/ℓ. A second sample contained total priority pollutant volatile organic compound (VOC)

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concentrations as high as 2,300 mg/ℓ. A third sample contained approximately 50 mg/ℓ of total base neutral-acid extractables (BNAs) included on the Priority Pollutant List.

Free swell tests using organic solvents, salt, and tap water were conducted on four commercially available bentonites. Sodium chloride showed the most impact on the free swell capacity of the bentonite samples by always reducing the free swell capacity of the samples as compared to the control tap water samples. The organic solvents produced variable results with the bentonite samples, sometimes increasing their free swell capacity over the controls and sometimes decreasing it. From the free swell testing, one bentonite was chosen for use in preparing the SB slurry wall backfill mixtures.

Six clay borrow sources from the Gary, IN, area were screened using Atterberg limits and grain size analysis. A high plasticity soil (CH) and medium plasticity soil (CL) were chosen as borrow materials for the preparation of the two SB slurry wall backfill mixtures.

The backfill mixtures were prepared by adding enough 6.0-percent bentonite slurry to the two clay borrow samples to achieve at least a 4.0-in. slump. The water contents of the backfill materials were 49.5 and 41.1 percent for the CH and CL clay backfills, respectively.

Each backfill mixture was loaded into eight rigid wall permeameters. Sidewall leakage inside the permeameters was controlled by the application of bentonite paste along the inside of the permeameter cell walls. All sixteen permeameters were run in Phase I with tap water; then in Phase II, six permeameters for each backfill mixture were permeated in duplicate with the three contaminated ground-water samples (i.e., two permeameters per ground-water sample), while the remaining two permeameters, or control cells, continued to be permeated with tap water. The three permeants from the wells produced varied hydraulic conductivity results. However, the solutes had little or no effect on the hydraulic conductivities of the backfill mixtures.

PREFACE

This study was conducted as part of the Superfund Feasibility Study of the Ninth Avenue Dump Superfund Site by The US Army Engineer Waterways Experiment Station (WES), Vicksburg, MS. This report was prepared by WES, in cooperation with the US Army Engineer District, Omaha (CEMRO) and Region V of the US Environmental Protection Agency (USEPA). Coordination and management support were provided by CEMRO. This study was conducted between June 1988 and July 1989.

Project manager for the USEPA was Ms. Allison Hiltner. The CEMRO project manager was Mr. Steve Rowe. The WES project manager was Mr. Mark E. Zappi.

The study was conducted and the report prepared by Messrs. Mark E. Zappi and Richard A. Shafer, and Dr. Donald D. Adrian of the Water Supply and Waste Treatment Group (WSWTG), Environmental Engineering Division (EED), Environmental Laboratory (EL), WES. The Analytical Laboratory Group, EED, under the supervision of Ms. Anne Strong assisted with chemical analysis of samples. The Soils Testing Facility, Geotechnical Laboratory, WES, under the supervision of Mr. Jesse Oldham, assisted in the geotechnical testing of the soil and soil-bentonite samples. Warzyn Engineering, Inc. of Madison, WI, obtained the ground-water samples. Mses. Cindy Teeter and Sharon Burke and Messrs. Greg Philips and Sidney Ragsdale, WSWTG, assisted in the design and daily operations of the permeameters. Ms. Kellie Huff, WSWTG, assisted in the reduction and presentation of the data. This report was edited by Ms. Janean Shirley of the WES Information Technology Laboratory.

The study was conducted under the general supervision of Mr. Norman R. Francingues, Jr., Chief, WSWTG; Dr. Raymond L. Montgomery, Chief, EED; and Dr. John Harrison, Chief, EL.

COL Larry B. Fulton, EN, was Commander and Director of WES. Dr. Robert W. Whalin was Technical Director.

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CONTENTS

CONVERSION FACTORS, NON-SI TO SI (METRIC) UNITS OF MEASUREMENT

Non-SI units of measurement used in this report can be converted to SI (metric) units as follows:

Multiply	By	To Obtain
acres	4,046.873	square metres
degrees	0.01745329	radians
feet	0.3048	metres
gallons (US liquid)	3.785412	cubic decimetres
inches	2.54	centimetres
pounds (force) per square inch	6.894757	kilopascals
square feet	0.09290304	square metres

GROUND WATER COMPATIBILITY OF NINTH AVENUE SUPERFUND SITE AND TWO SOIL-BENTONITE SLURRY WALL BACKFILL MIXTURES

PART I: INTRODUCTION

Site History

1. The Ninth Avenue Dump Site is listed on the US Environmental Protection Agency's (USEPA) National Priorities List of hazardous waste sites scheduled for cleanup under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 as amended by the Superfund Amendments and Reauthorization Act of 1986. The site is a 17-acre* inactive chemical waste disposal area located in Gary, IN. Figure 1 is a location map that illustrates the approximate location of the site.

2. The site is situated in an industrial area, although properties adjacent to the site are relatively undeveloped. The site topography is a relatively flat area with poor drainage and is characterized by small depressions and mounds from past disposal and/or cleanup activities.

3. Both solid and liquid wastes are reported to have been disposed on the site. Solid wastes included industrial construction and demolition wastes. Liquid wastes included oils, paint solvents and sludges, resins, acids, and other chemical wastes. Waste disposal operations took place between 1973 and 1980.

4. Warzyn Engineering, Inc. of Madison, WI, working under contract with the US Army Engineer District, Omaha, completed a remedial investigation (RI) and remedial action feasibility study (FS) for the site. The RI concluded that significant contamination of the site had occurred from past disposal operations. The site ground water is contaminated with a variety of inorganic and organic contaminants. Inorganic contamination is mainly in the form of sodium chloride (road salt). The suspected source is a State of Indiana Highway Department storage area located nearby. Other inorganic contaminants found in the ground water are calcium, magnesium, and potassium. A variety of

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* A table of factors for converting non-SI units of measurement to SI (metric) units is presented on page 3.

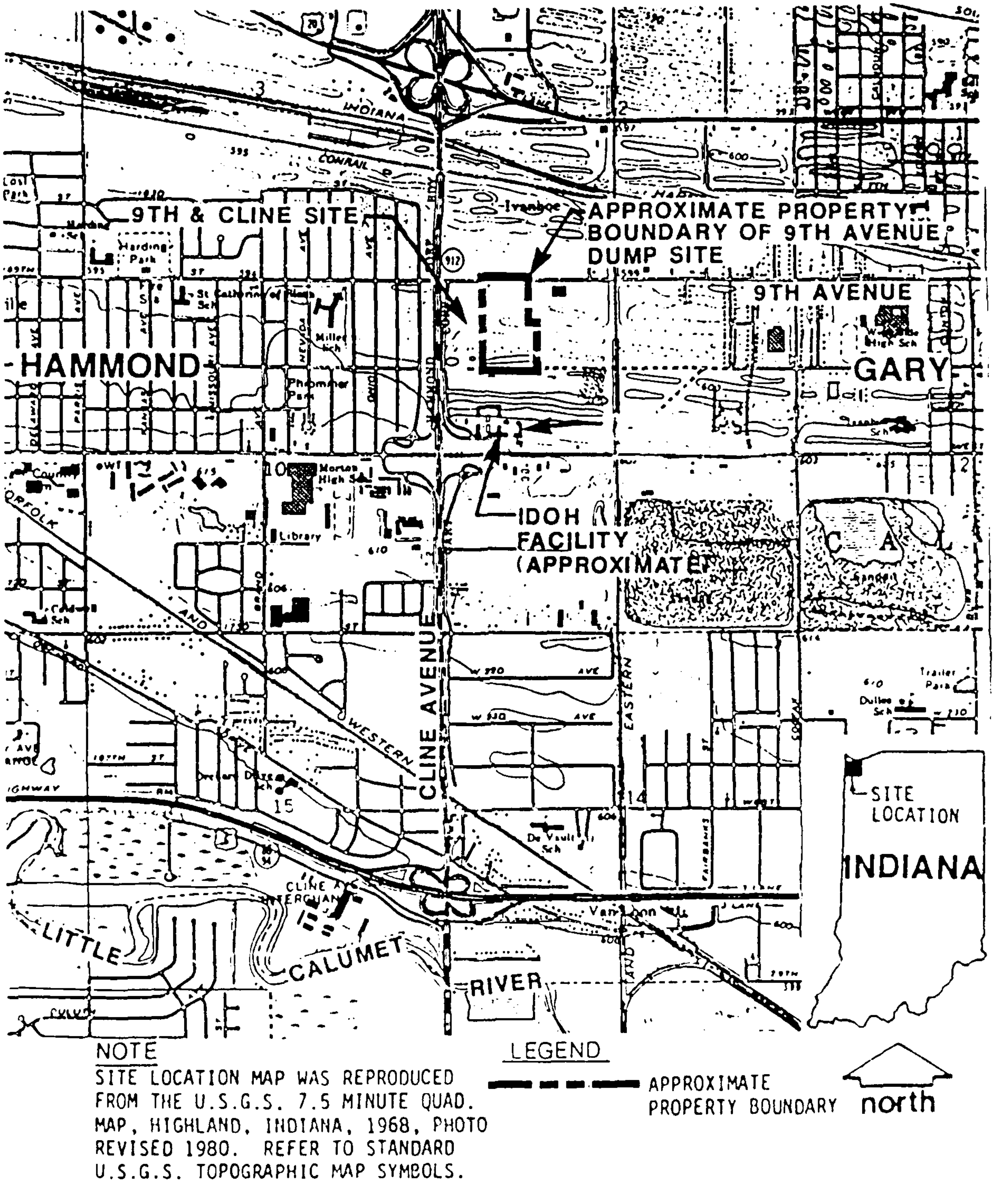

Figure 1. Site location map

organic contaminants were also detected in the ground water during the RI. Most prevalent of the organic contaminants detected were ketones. Also detected in significant concentrations were benzene, ethylbenzene, toluene, xylene (BETX), polyaromatic hydrocarbons (PAHs), and total chlorinated ethenes.

5. In order to eliminate the continued migration of contaminants via ground-water transport and to facilitate site cleanup, a soil-bentonite (SB) slurry wall has been proposed by Warzyn in the RI/FS as a means of containment. Proposed locations for the slurry wall and a more detailed site description can be found in a report by Warzyn Engineering, Inc. (1988).

SB Slurry Walls

6. SB slurry walls have been used in the United States since the 1950s for seepage control at large hydraulic structures such as locks and dams (D'Appolonia 1980). Due to this vast experience with SB slurry walls as a means of ground-water containment and diversion, SB slurry walls are being considered as a means of contaminant containment during site remediation activities at many Superfund sites.

7. The SB slurry wall serves as a means for preventing clean ground water from flowing through a contaminated aquifer and, thereby, generating more contaminated ground water. The SB slurry wall also acts to contain contaminated ground water, allowing the contaminated ground water to be collected and treated.

8. SB slurry walls are typically installed by first digging a narrow 2- to 4-ft-wide trench, using either a dragline or a backhoe, around the area containing the contaminated ground water, as illustrated in Figure 2. During excavation of the trench, bentonite slurry is pumped into the excavated area to support the sides of the trench. Typically, the trench extends at least 2-3 ft into an aquiclude. This is commonly referred to as "keying" the slurry wall into the aquiclude. At the same time as the excavation equipment moves along excavating the trench, borrow material is mixed with the bentonite slurry to form a bentonite slurry/borrow material mixture commonly referred to as the SB backfill mixture. The SB backfill mixture is added to the trench once the excavation equipment has moved far enough along so that the addition of the backfill does not interfere with excavation activities. The final

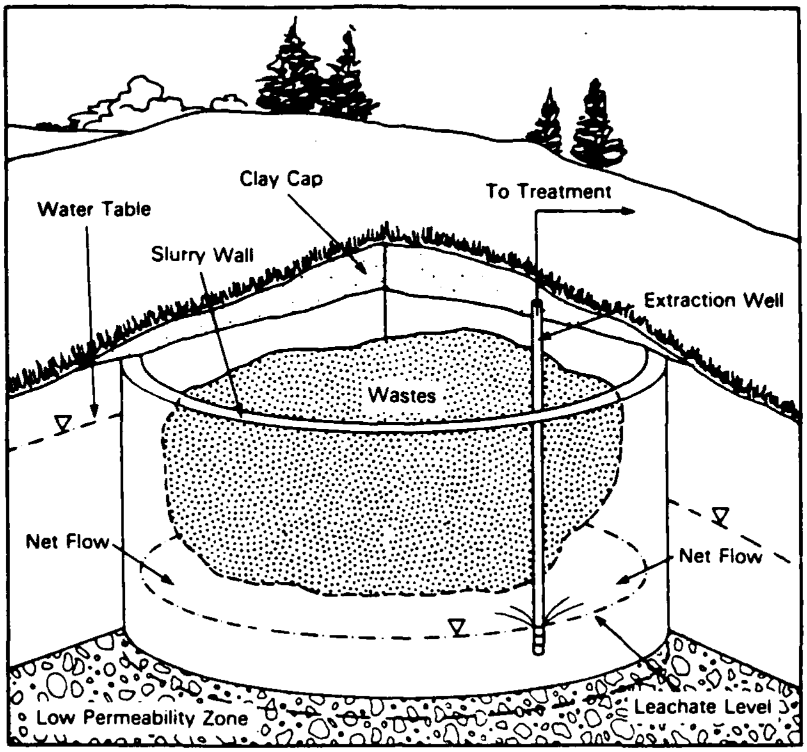

Figure 2. Cross section of circumferential wall placement (from USEPA 1984)

product is a wall of backfill material that has a very low hydraulic conductivity. Typical SB slurry wall construction methods are illustrated in Figure 3, while Figure 4 illustrates a typical SB slurry wall construction site.

9. In most cases, the borrow material is simply the soil that was excavated from the trench. However, the Ninth Avenue Site has a relatively high percentage of sand and gravel requiring that a borrow material with more suitable characteristics for use in slurry wall construction be trucked in.

Potential Compatibility Problems

10. Many of the contaminants found in the site ground-water samples (i.e., acetone, phenol, and sodium chloride), have been identified as potentially having adverse chemical interactions with clays, resulting in increased hydraulic conductivity (Anderson and Jones 1983; Evans, Fang, and Kugelman 1985). Although these contaminants are present in the site ground water, their concentrations are not nearly as high as those tested in the

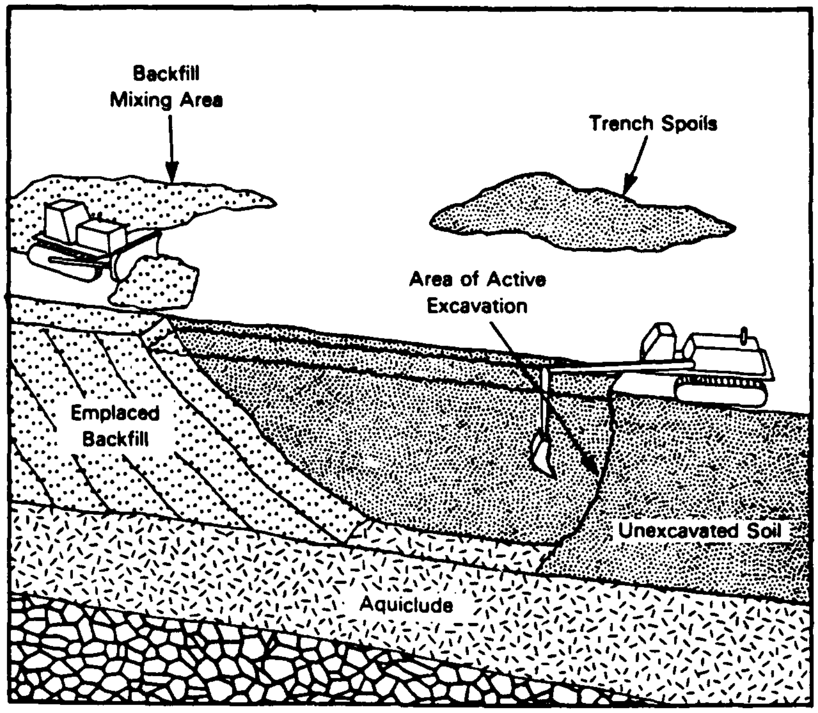

Figure 3. Excavation and backfilling operations
(from USEPA 1984)

above-mentioned research efforts. In fact, most of the research efforts to date concerning chemical interaction between contaminants and clay particles have been performed using either pure or highly concentrated solutions. The concentrations of contaminants in the ground-water samples are high in terms of an environmental pollution problem, but not in terms of possible chemical interaction between the contaminants in the ground water and the soil particles in the SB backfill materials. Because little or no research in the area of chemical interactions of moderately contaminated solutions with clay particles has been documented, compatibility testing must be performed to assess if the contaminants in the ground water will adversely change hydraulic conductivity of the SB slurry wall.

Study Objective

11. The objective of this study was to use laboratory testing to determine whether contaminants in the site ground water will have an adverse effect on the hydraulic conductivity of an SB slurry wall. An adverse effect

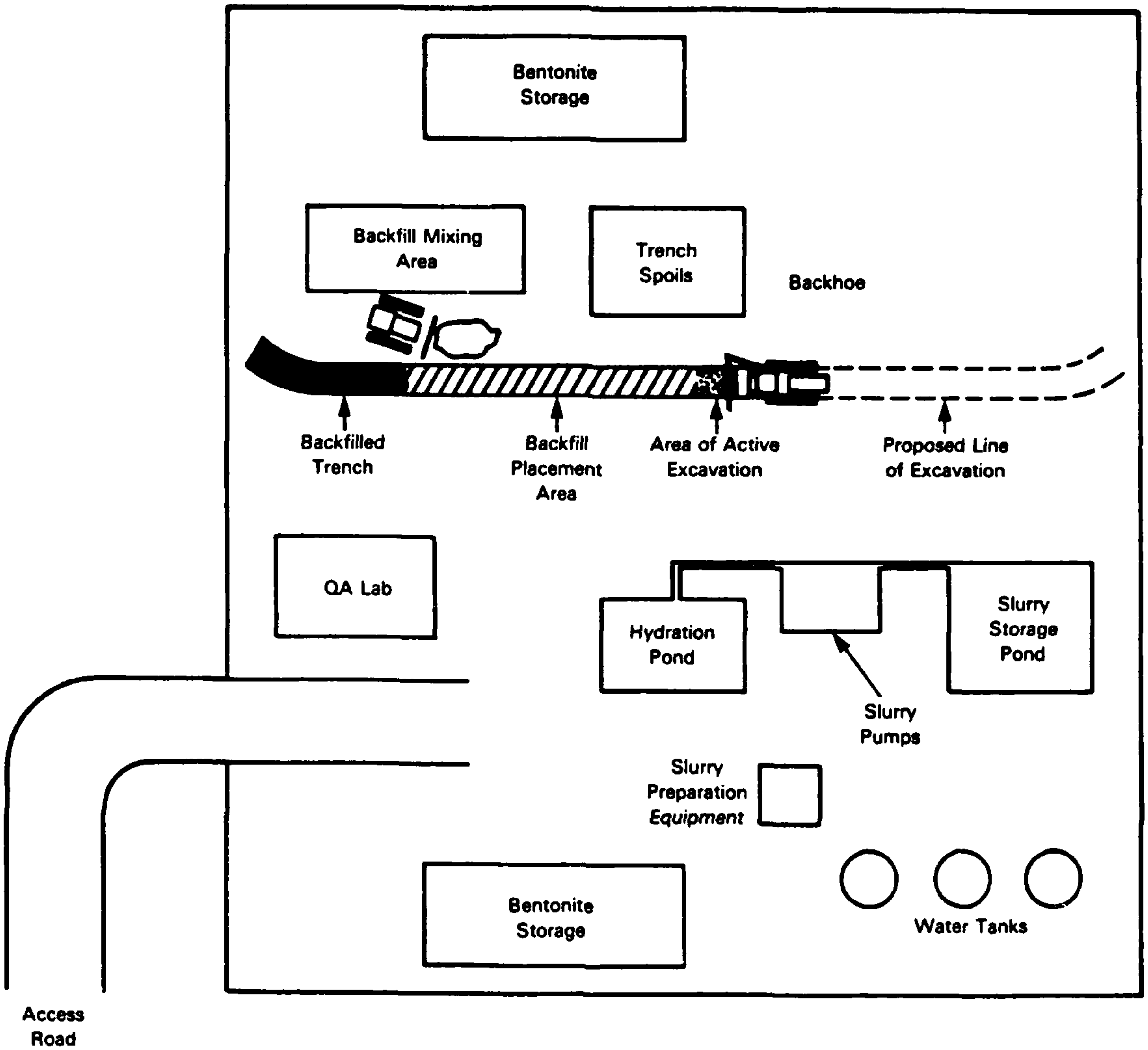

Figure 4. Typical slurry wall construction site
(from USEPA 1984)

would be observed as an increase in the hydraulic conductivity of the SB backfill material after exposure to the chemicals in the contaminated ground water.

Scope of Study

12. The scope of this study included compatibility testing of two SB backfill mixtures with ground-water samples from three site observation wells that were formulated as part of this study. The mixture formulations were

based solely on technical considerations and not on an analysis of the projected costs associated with the construction of an SB slurry wall at the site. A cost analysis of the SB construction options, or other types of contaminant containment methods for that matter, was not within the scope of this study.

13. During the RI, Warzyn Engineering also concluded that an oil layer was floating on the surface of the ground water. Compatibility testing of the oil layer with the SB backfill mixtures was not within the scope of the work conducted by the US Army Engineer Waterways Experiment Station (WES).

PART II: STUDY APPROACH

Introduction

14. Compatibility of the proposed SB slurry wall with the contaminated ground water was determined through permeability testing of two SB backfill mixtures with test permeants consisting of tap water from the City of Gary, IN water system and contaminated ground-water samples from the Ninth Avenue Superfund site. The long-term stability of two SB slurry wall backfill mixtures in terms of hydraulic conductivity was determined through laboratory testing using rigid wall permeameters operated at elevated hydraulic gradients.

General Description of Study Approach

15. The general approach to determining compatibility of the contaminants in the ground water with an SB slurry wall included the following tasks:

- a. Select a bentonite source for formulation of the two SB backfill mixtures.
- b. Select two borrow material sources for use in formulating two SB backfill mixtures.
- c. Use the selected bentonite and the two borrow material samples to formulate two laboratory-processed SB backfill mixtures.
- d. Load samples of each of the two SB backfill mixtures into 16 rigid wall permeameters (8 permeameters per backfill mixture).
- e. Determine the initial or baseline hydraulic conductivity of the mixtures using City of Gary, IN tap water as permeants for all 16 cells.
- f. Evaluate the compatibility of the ground water with the two SB backfill mixtures by determining if significant changes in hydraulic conductivity occurred when contaminated ground-water samples from three site observation wells (X-1, X-14, and X-25) were used as permeants.

16. The ground-water samples from the three observation wells contain concentrations of various contaminants that are known to have detrimental effects on clay materials such as bentonite (Anderson and Jones 1983). Ground-water samples from observation wells X-1, X-14, and X-25 were selected for use in compatibility testing with the two SB backfill mixtures based on

the results of chemical analysis of the ground-water samples during the RI. Ground-water samples from these wells contained the maximum concentrations (as compared to the observation wells sampled) of contaminants that may be incompatible with an SB slurry wall. These contaminants were categorized as inorganic salts (NaCl), ketones, BETX compounds, and phenols. Based on the results from the RI, well X-1 contained high concentrations of inorganic salts with little or no organic contamination. Well X-14 contained the maximum concentrations of BETX and phenolic compounds. Finally, well X-25 contained the maximum concentrations of ketones of all the ground waters analyzed. The overall study approach is outlined in Figure 5. This approach is presented in detail in the following discussions.

Chemical characterization of ground-water samples

17. Ground-water samples from site observation wells X-1, X-14, and X-25 were analyzed for total organic carbon (TOC), conductivity, pH, alkalinity, sodium, chloride, and bromide. The ground-water samples were also analyzed for base-neutral/acid extractables (BNAs) and volatile organic analysis compounds (VOAs) found on the USEPA Priority Pollutant List. Single replicates were analyzed before the permeant reservoirs were filled with the ground-water samples. Chemical analytes and their respective analytical detection limits are presented as Appendix A. The permeants contained in the permeant reservoirs were also analyzed approximately halfway through the course of permeability testing to assess the amount of volatile organic contaminant loss associated with the long period of time the permeants remained in the permeant reservoirs. These analyses were used to monitor the stability of the permeants (ground-water samples) throughout the course of compatibility testing in order to insure permeant chemical homogeneity.

Preparation of permeants

18. The ground-water samples used as permeants were spiked with enough potassium bromide to increase the bromide concentrations in the permeants by 100 mg/ℓ. Therefore final permeant bromide concentrations were approximately 200-300 mg/ℓ, due to differing concentrations of bromide initially in the ground-water samples before bromide spiking. The bromide served as a nonreactive tracer for determining chemical breakthrough characteristics and to evaluate spiking and permeameter cell hydrokinetics.

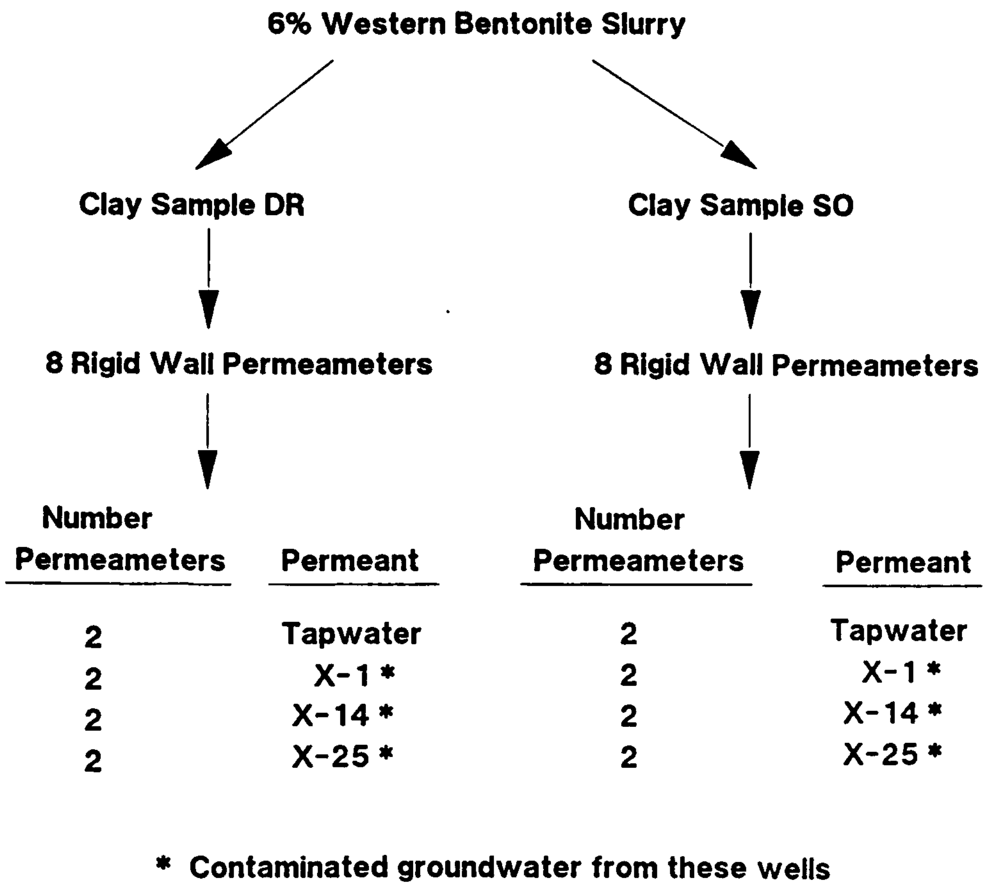

Figure 5. Study outline for permeameter tests

Plexiglas compatibility

19. In order to reduce costs, the permeameters for this study were constructed of Plexiglas. Some concern was felt as to the durability of a Plexiglas permeameter with several of the chemical solvents that were detected during the RI in the ground water. Ketones, esters, and aromatic hydrocarbons are reported to act as solvents for Plexiglas. For example, methyl ethyl ketone (MEK, 2-butanone), MIBK (4-methyl-2-pentanone), and acetone are strong solvents for plastic type materials such as Plexiglas (Verschueren 1983). Therefore, before the rigid wall permeameters were constructed, the compatibility of Plexiglas with elevated concentrations of MEK, MIBK, and acetone was evaluated.

Evaluation of bentonite sources

20. The bentonites in SB slurry walls used to contain water contaminated with hazardous constituents must have a stable and consistent hydration

volume that does not significantly change when exposed to a variety of contaminants. Any significant decreases in hydration or free swell volume could adversely affect the field hydraulic conductivity of the SB slurry wall. Therefore, a bentonite that exhibits a significant decrease in free swell volume when exposed to site contaminants should not be considered as suitable for use in the construction of an SB slurry wall.

21. Bentonite samples from four commercial sources were evaluated in order to find an appropriate bentonite for use in formulating the bentonite slurry used in the preparation of the two SB backfill mixtures. The bentonites were evaluated for their ability to exhibit a consistent free swell volume when exposed to a variety of contaminants at levels significantly higher than those found in the site ground water. Laboratory-prepared solutions of tap water mixed with various pure solvents at concentrations greater than those found in the site ground water were prepared and used as hydration fluids during free swell testing of each bentonite sample. A complete list of the contaminants (and their respective concentrations) used during free swell testing of the bentonites is presented in Part III of this report.

Evaluation of the borrow sources

22. Six sources of borrow materials located within the vicinity of Gary, IN were evaluated using Atterberg limits, soil classification (Unified Soil Classification System, USCS), and percent fines (determined through both sieve and hydrometric gradation analysis). According to D'Appolonia (1980), SB slurry wall hydraulic conductivity is a function of the percent fines (percent that passes a No. 200 sieve) of the borrow material used in the formulation of the SB backfill material. The greater the percentage of fines, the lower the hydraulic conductivity of the SB backfill mixture. The USEPA (1984) recommends a high plasticity borrow material. Soil plasticity is determined by the plasticity index (PI). A higher PI value represents a more plastic soil. A high plasticity soil used as a borrow material will produce an SB backfill mixture with a lower hydraulic conductivity than an SB backfill mixture formulated with a lower plasticity borrow material.

23. Using the criteria discussed above, the six borrow sources were classified as good, fair, and poor. Two borrow sources, one good and one fair, were chosen for use in formulating the two SB backfill mixtures that were used in this study (see Part III: Materials and Methods).

24. The two borrow materials chosen for use in formulating the SB backfill mixtures were further characterized by analyzing the soils for pH, cation exchange capacity (CEC), TOC, sodium, calcium, magnesium, and potassium.

Formulation of SB backfill mixtures

25. The bentonite slurry was used to formulate two SB backfill mixtures. One SB backfill mixture was prepared by using the good borrow source, while the second SB mixture was prepared with the fair borrow source. The porosity (n) of the two SB backfill mixtures was determined in order to calculate the pore volume of the backfill mixture loaded into each permeameter.

Permeameter testing

26. Of the 16 permeameter cells, 8 were loaded with one of the two SB backfill mixtures while the remaining 8 cells were loaded with the other SB backfill mixture. Initially, all test cells were permeated with tap water to determine the baseline hydraulic conductivity of the SB backfill mixture in each cell. Although eight replicate cells contained the same SB mixture, slight differences in loading each of the cells could produce differences in the observed hydraulic conductivity for each cell. For this reason, tap water was permeated in all cells so that a baseline hydraulic conductivity could be determined for each cell.

27. After at least one pore volume of tap water was permeated through each cell, six of the eight cells for each SB backfill mixture were permeated with contaminated ground water collected from the three site observation wells. Samples from each of the three site observation wells were permeated through two replicate cells for each SB backfill mixture. Two of the eight cells for each SB backfill mixture continued to be permeated with tap water throughout the course of permeability testing. These four cells (two cells for each SB backfill mixture) served as test control cells. The control cells were used to determine if any changes in hydraulic conductivity were due to physical changes in the SB backfill mixture caused by operational adjustments made during testing and not due to chemical interaction between the backfill mixtures and ground-water contaminants. Examples of such physical changes caused by operational adjustments include wall effects and consolidation of the SB mixtures resulting from increased hydraulic gradients.

Analysis of permeants

28. The permeants from each permeameter were collected daily and stored in separate 500-ml plastic sample bottles. After at least one pore volume of

permeant was collected from each cell, the permeants from each cell were analyzed for TOC, pH, alkalinity, sodium, calcium, chloride, bromide, and conductivity. These data were used to estimate the amount of contaminant adsorption/desorption that may have occurred during permeation of the ground water and tap water through the backfill samples.

29. Significant changes in cation concentrations can have a detrimental effect on soil permeability. If the soil sodium concentrations significantly increase, then the permeability of the soil decreases. If the sodium concentration is reduced due to substitution of the sodium with calcium or magnesium, the soil permeability increases. Alkalinity, pH, conductivity, TOC, and anion concentrations were determined to characterize contaminant mobility profiles.

PART III: MATERIALS AND METHODS

Materials

City of Gary, IN tap water

30. The tap water used during this study was obtained from the Gary-Hobart Water Corporation, which serves the area in which the site is located. Since this water source is most likely the water that will be used during construction of the SB slurry wall, it was used to prepare the backfill mixtures and was one of the permeants used during permeability testing of the two SB backfill mixtures. The tap-water samples were collected by Gary-Hobart personnel in plastic 1.0-gal bottles and shipped in ice chests to WES via overnight delivery. The tap-water samples were stored at a temperature of 4° C in a walk-in cooler until needed.

Contaminated ground-water samples

31. In December, 1988, Warzyn Engineering collected 2.5 gal of ground water from each of these site observation wells: X-1, X-14, and X-25. The ground-water samples were collected in 0.5-gal glass jugs with Teflon-lined caps. The jugs were completely filled in order to reduce the amount of headspace available for contaminant loss through volatilization during shipment of the samples to WES. The jugs were placed in ice chests and shipped to WES via SET Environmental Waste Haulers of Chicago, IL. Upon arrival at WES, the samples were placed under chain of custody and stored in a walk-in cooler at 4° C until needed for compatibility testing.

Bentonite samples

32. Samples of four proprietary bentonites were sent to WES by Warzyn Engineering for evaluation as candidate bentonite sources for use in formulating the two backfill mixtures. Two of the bentonite samples were National-Premium Western Bentonite and Enviro-Seal, manufactured and distributed by N.L. Baroid, Inc. of Houston, TX. The other two samples were Saline Seal 100-Granular and Custom Sealant 50, manufactured and distributed by American Colloid Company of Arlington Heights, IL.

Clay borrow samples

33. Warzyn Engineering determined during the FS that the soil excavated from the proposed SB slurry wall site was too sandy for use as a borrow

material in the formulation of an SB slurry wall backfill mixture. Therefore, the USEPA and the Omaha District agreed to evaluate alternate soil borrow sources for use in constructing the SB slurry wall. Warzyn Engineering, prior to the initiation of this study, had identified three sources of clay borrow material within the Gary, IN vicinity. WES identified four more sources of borrow soils high in clay content also from the Gary, IN vicinity. WES requested that all seven vendors of the clay borrow materials submit 10-gal soil samples for evaluation as a borrow material source. Six of the seven borrow pit operators sent soil samples to WES for evaluation as a prospective borrow source for use in formulating an SB backfill mixture. A list of participating borrow pit operators is presented in Table 1. Each vendor was sent two empty 5.0-gal buckets with air-tight seals. Each operator filled the buckets with soil samples from his respective site and returned them to WES via second-day air. The soil samples were stored at room temperature at WES until needed for testing.

<u>Rigid wall permeameters</u>

34. Sixteen rigid-wall Plexiglas permeameters were constructed at the Model Shop of the WES Engineering and Construction Services Division. The permeameters were constructed with 4-in.-long columns as shown in Figure 6. The longer columns were provided in case longer sample lengths were required during testing, wall effects should become significant, or other measures failed to control the wall effects. The inside walls of the permeameter columns were roughed up with a stainless steel brush as an attempt to increase the coefficient of friction along the cell walls, and thereby reduce sidewall leakage. Porous stones with thicknesses of 0.25 and 0.50 in. were used to support the samples inside the permeameters. The porous stones used were purchased from Soil Test, Inc. of Evanston, IL. Whatman GF/D brand filter paper with a nominal pore size opening of 0.7-1.0 μ was inserted between the porous stones and the permeameter bottom. An all-Teflon geotextile material was inserted under the test cell samples in order to keep sample solids from migrating into the porous stones during permeability testing. Geotextile material was used because it is stronger than the filter paper and would not tear while the permeability samples were spooned into the permeameters. The geotextile material was purchased from Fabricated Filters, Inc. of Harahan, LA. The permeameters were set up as illustrated in Figure 7. Bottled nitrogen was used as the pressure source for the reservoirs. One pressure

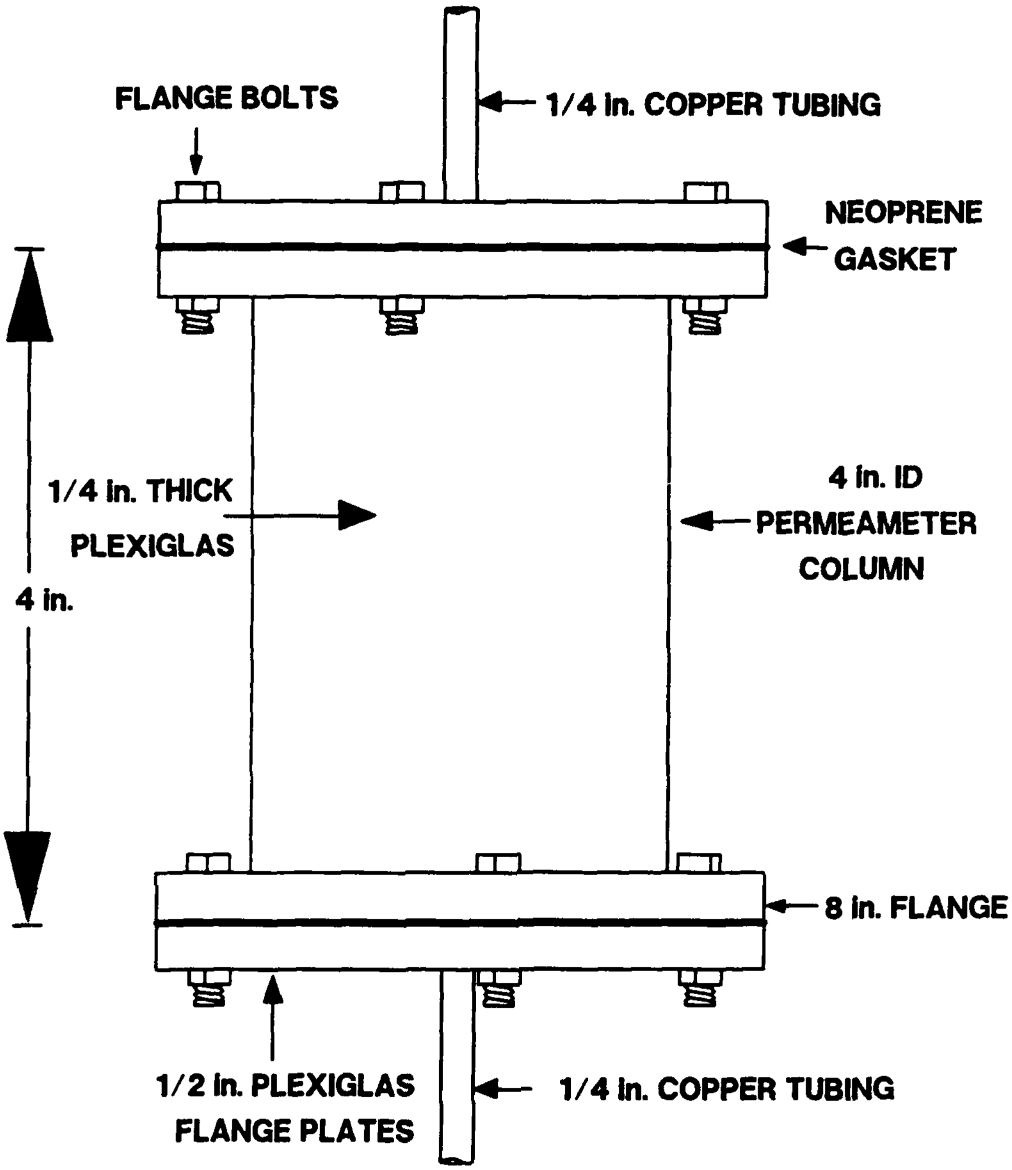

Figure 6. Rigid wall permeameter

reservoir was used to pressurize and deliver the permeants to two separate permeameters. This arrangement served as duplicate permeameter sets for each SB backfill mixture sample and respective permeant. Therefore, 16 permeameters required 8 pressure reservoirs. The pressure reservoirs were constructed identically to the permeameters except that they had column lengths of 12 in. Copper tubing, 1/4 in. OD, was used to connect the reservoirs to the permeameters.

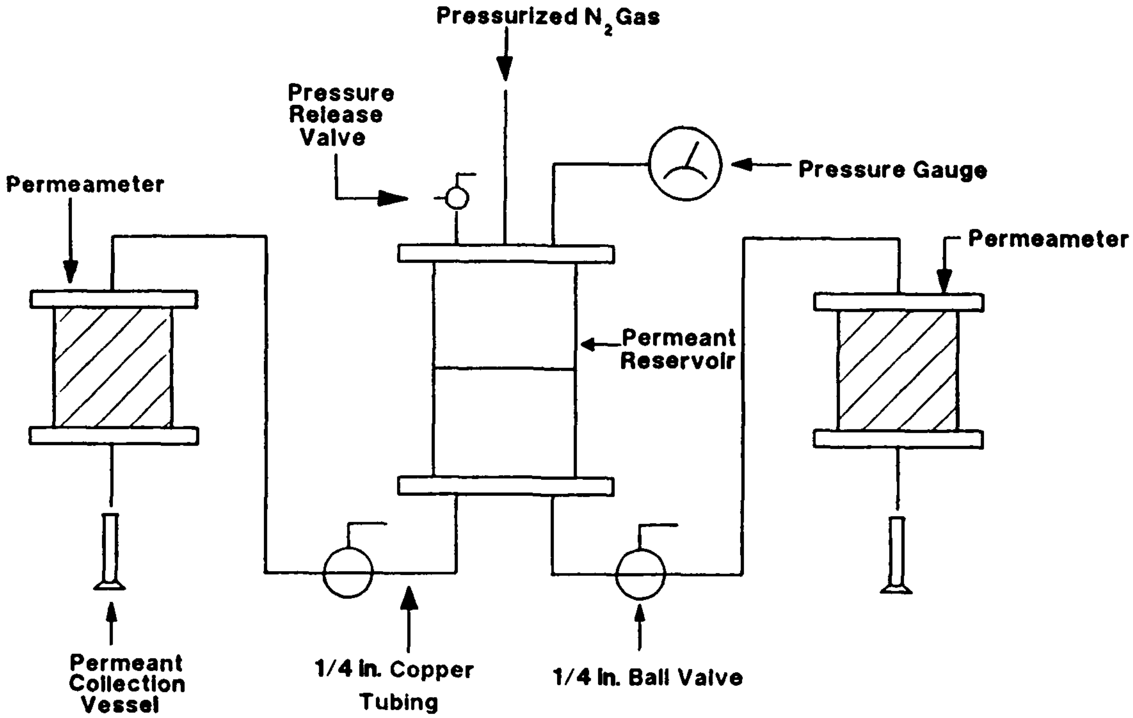

Figure 7. Rigid wall permeameter system

35. The system pressure was regulated with an Air Products model E12-U-C-144A, research grade, two-stage nitrogen regulator. This regulator has an operating range of 0-15 psi and is capable of maintaining pressures to within ±0.1 psi. System pressure was monitored using a Weika model 232.33 process gage. The operating pressure for the Weika gage ranged from 0 to 15 psi with an accuracy of ±0.1 psi. Permeant volumes were collected and measured daily in 100-ml graduated cylinders with accuracies of ±0.05 ml.

Methods

Free swell testing

36. Free swell test methods were performed according to the methods described by McCandless and Bodocsi (1987) with the exception of two deviations from the prescribed method. The method described by McCandless and Bodocsi requires that 2 g of dry bentonite be sprinkled into a 100-ml glass graduated cylinder containing 100 ml of deionized water. At the 2- and 24-hr intervals, the volume occupied by the bentonite in the cylinders is recorded as the free swell volumes of the bentonite at test times 2 and 24 hr. One

deviation from the prescribed method was that tap water from the Hilldale Water District, a water company located in Vicksburg, MS, was used during free swell testing instead of deionized water. This deviation from the methods was made because the water chemistry of Hilldale Water District tap water is very similar to Gary-Hobart tap water, the likely water source to be used during construction of the SB slurry wall at the site.

37. The second deviation from the prescribed free swell test method was that a glass stirring rod was used to push the floating particles of bentonite down into the tap water to hydrate them. During the initial free swell testing, some of the bentonite particles were floating on the water surface for long periods of time until becoming hydrated and sinking down into the cylinder. Therefore, a glass stirring rod was used to push the bentonite particles down into the water at the initiation of free swell testing in order to quickly submerge all the bentonite particles. After pushing all the bentonite particles into the tap water, the stirring rod was rinsed with tap water over the graduated cylinder to remove bentonite particles which may have adhered to the glass stirring rod. The small particles of bentonite could not be excluded from the determination of the free swell capacity; therefore, rinsing them from the glass rod into solution was important in the determination of an exact free swell capacity. The initial free swell tests were rerun using a glass rod to submerge the bentonite particles.

38. Free swell tests were run on all bentonite samples using Hilldale tap water and solutions of tap water and acetone, (MEK), toluene, and sodium chloride. Concentrations of each of the solutions used for swell testing are presented in Part IV of this report.

Preparation of bentonite slurry

39. Dry bentonite was mixed with Gary-Hobart tap water to formulate the bentonite slurry. Various bentonite additive ratios were evaluated. Enough bentonite was added to give a Marsh funnel viscosity reading ranging between 40 and 50 sec. The slurry was mixed using a Hobart Model C-100 shearing type mixer. After the bentonite slurry was mixed and the Marsh funnel reading was taken to determine if the slurry had an appropriate viscosity, the slurry was poured into a 5-gal plastic pail, sealed, and stored at room temperature until needed for preparing the two test SB backfill mixtures.

Geotechnical testing of
soils and SB backfill mixtures

40. All geotechnical testing was performed by the Soils Testing Division of the Geotechnical Laboratory, WES. The procedures followed are described in US Army Corps of Engineers (USACE) Engineering Manual 1110-2-1906 Laboratory Soils Testing (USACE 1980). The six candidate borrow sources were tested for Atterberg limits, USCS soil classification type, water content, and percent fines. The SB backfill mixtures used in the permeameter tests were characterized in terms of porosity, water content, Atterberg limits, soil classification, and percent fines.

Preparation of backfill mixtures

41. The two SB backfill mixtures used in the permeameter testing were prepared using the bentonite slurry and the two selected borrow sources. Before mixing with the bentonite slurry, samples from both borrow sources were dried separately at 65° C in laboratory ovens for 4 days. Samples for water content analysis were collected from each borrow source before and after drying. Water content analysis was performed using methods discussed in the Methods section of this report. After drying, the borrow samples were broken up using a mortar and pestle, then sieved through a No. 4 US standard sieve (4.75-mm opening) in order to remove any large pieces of debris or rocks from the samples. Samples from both borrow sources that were dried and passed through a No. 4 US standard sieve were observed to contain many small pebbles. Since these pebbles could cause short-circuiting and/or wall effects in the permeameters during permeability testing, the samples were again sieved through a No. 10 US standard sieve (2.00-mm opening) to remove the pebbles.

42. After the borrow samples were sieved through the No. 10 US standard sieve, the borrow samples were reconditioned to within 2 percent of their original water content by gradually adding Gary-Hobart tap water to the dried and sieved samples. The tap water was applied to the borrow with an aspirator and mixed into the borrow samples by hand using a small laboratory scoop. The reconditioned samples were allowed to equilibrate in sealed 5-gal buckets for a 7-day period at room temperature. This equilibration period was important because it allowed the tap water to soak back into the soil particles. During the equilibration period, the samples were mixed daily by hand using the laboratory scoop. Water content determinations were made after 7 days on the

reconditioned samples to confirm that the samples were reconditioned to within 2 percent of their original field water content.

43. The bentonite slurry, in 500-ml increments, was added slowly and mixed with the borrow soil. Mixing of the bentonite slurry and borrow materials was performed by hand using a small laboratory scoop. After each 500-ml addition of slurry, a slump test was performed on the backfill mixtures. Addition of water was continued until a slump greater than 4 in. was achieved. Slump tests were performed according to the procedures listed in American Society for Testing and Materials (ASTM) Test Method C-143-71 (Herubin and Marotta 1981). The SB backfill mixtures were stored in sealed plastic 5-gal pails at room temperature until they were loaded into the permeameter cells.

Permeameter testing

44. The rigid wall permeameters were initially configured in an up-flow mode. All of the porous stones used in the permeameters were boiled in Gary-Hobart tap water for at least 30 min to remove all air and ensure that the stones were completely saturated with tap water. Dry bentonite was dusted on the inside of the cells before spooning the samples into the cells in order to reduce the potential for sidewall leakage of the permeants. The SB backfill mixture was spooned onto the geotextile material covering the porous stones in approximately 1/2-in. lifts. Extreme care was taken to insure that air was not trapped between the freshly spooned samples and the porous stones. Trapped air within the SB samples affects the accuracy of the hydraulic conductivity measurements by reducing the hydraulic conductivity values observed. The length of the samples from both SB backfill mixtures loaded into all permeameters was approximately 2 in. Exact individual sample lengths were measured and recorded by measuring the distance from the top of the cell cylinder to the surface of the filter paper that was laid on the top stone supporting the SB backfill samples.

45. After the SB backfill samples were loaded into the cells, the distance from the top of the samples to the cell top was measured. The difference between the pre- and post-loading measurements was recorded as the sample length. SB backfill length measurements for each cell were made at four points along the top of the cells. These measuring points were located approximately 90 deg apart from each other (i.e., measuring points were located at angles of 0, 90, 180, and 270 degrees from reference). The four

individual length measurements for each cell were recorded and averaged to calculate a single sample length.

46. Once the test cells were loaded with the SB backfill mixture, they were kept at a pressure head of approximately 2 in. of water for 1 week to allow the bentonite dusted on the permeameter sides to hydrate completely and thereby "seat" or seal off the cell walls. After 1 week had passed, a hydraulic gradient of 0.5 ft/ft was applied to the permeameters with a significant flow of permeant through the permeameters observed. Visual observations of the permeameters indicated that channels that had formed along the sides of the cells were allowing permeant to flow along the walls, bypassing the SB backfill samples, thus flowing directly into the permeant collection vessels. It was also observed that when pressure was exerted on the SB backfill samples, the force exerted on the sample bottoms due to the pressure differential slightly lifted the SB backfill samples. This upward movement of the samples seemed to increase the formation of the channels along the cell walls.

47. Eight cells were unloaded and reloaded with fresh material in an attempt to determine if loading procedures, permeameter configuration, and changing the permeameter design would eliminate or significantly reduce the flow of permeants along the cell walls. Two cells were configured in a downflow mode with no bentonite added to the cell walls. Two cells were configured in a downflow mode and had a 1/16-in. wet bentonite paste coating applied to the interior walls. Two cells were configured in an upflow mode with bentonite paste coating the interior cell walls. Two new permeameter cells were constructed without roughed interiors. These new cells were constructed to evaluate whether smooth walls with smaller coefficients of friction could reduce channel formation along the cell walls as the sample consolidated. The smooth walls should allow the samples to consolidate and slide along the wall without the wall roughness pulling the samples apart as they slide. Pulling apart of the samples was observed during the first loading of the samples into the permeameters when the pressure head was exerted on the samples. One big advantage of Plexiglas permeameters is that any structural changes in the samples inside the cells can be visually observed.

48. A pressure head of 1 psi (2.307 ft of water) was slowly exerted on all eight test cells by applying the pressure at 0.25-psi increments adjusted at 1-day intervals. The cells with the bentonite paste coating the walls all had very similar hydraulic conductivities regardless of configuration. The

cells with roughed-up interior walls seemed to be more stable than the smooth-wall cells in terms of sample movement in the cells. One distinct advantage observed in the downflow cells with bentonite-paste-coated walls over the upflow cells with bentonite-paste-coated walls was that during consolidation of the samples, the downflow permeameter samples consolidated downward in the direction of gravitational forces. The upflow permeameter samples consolidated in the direction opposite to gravity, leaving the sample bottoms slightly lifted off the porous stones against gravitational forces, allowing small bits of sample material to fall off the lifted sample over time. Bits of SB backfill samples falling from the permeability samples would result in changes in test sample length, because when a piece of sample falls off, it can no longer be considered as part of the test sample. Therefore, based on these special investigations, the downflow-configured cells with bentonite-paste-coated interior walls were chosen for use in permeameter testing of the two SB backfill mixtures. All 16 cells were unloaded and thoroughly cleaned. The cell walls were coated with .06 in. of bentonite paste and the test cells were reloaded according to the procedures discussed earlier.

49. Permeants from each cell were collected daily and stored in separate 500-ml plastic bottles until at least one pore volume of permeant was collected. The permeants were then analyzed as discussed earlier in this report. Permeameters were inspected daily and test parameter values were measured and recorded during the daily inspections. All measurements were recorded in a daily log. A sample of a daily log sheet is presented in Figure 8. A summary of the operational parameters for the permeameters and their respective permeants is presented in Table 2.

Chemical analysis of permeants and soil samples

50. All chemical analyses of permeants and soil samples were performed according to the procedures described in Analytical Methods Manual SW-846: Test Methods for Evaluating Solid Wastes (USEPA 1986).

9th Avenue Groundwater Compatibility Study

Daily Data Sheet

Temperature (C) 21° 78 ml | Date: 5 Dec 88

Atmospheric Press. (in.) 776 | Technician: T

Permeameter	P-Gauge	Hgt. H20	Time	Output Buret
1	3.075	1.7	12.40/60	5
2				7
3	2.975	1.65		7
4				5
5	3.050	2.7		6
6				off*
7	3.075	2.15		13
8				7
9	1.450	3.8		30
10				22
11	1.50	2.55		20
12				14.5
13	1.650	2.35		9
14				17.5
15	1.650	2.9		22.5
16				19

HNU Readings (EL):

DATE:

Comments: * turned #6 back on; all are doing OK; can see soil through bentonite-looks very dark-almost black (reduced?)

Figure 8. Daily permeability test log sheet

PART IV: RESULTS AND DISCUSSION

Chemical Analysis of Ground-Water Samples

51. The results of the chemical analysis of the ground-water samples from site observation wells X-1, X-14, and X-25 are presented in Tables 3 through 8. Tables 3 through 5 present the results of the two chemical analyses of the ground-water samples performed by WES and the analytical data from sampling rounds 1 and 2 as reported in the RI (Warzyn Engineering, Inc. 1988). The second WES analysis (February 1989) of the ground water consisted only of VOA analysis of the permeants in each of the permeant reservoirs at the approximate midpoint of permeability testing. This analysis was performed to evaluate the amount of volatile organic compounds lost due to volatilization occurring in the reservoirs during permeability testing. Tables 6 through 8 present the results from the single inorganic analysis of the ground water performed by WES and the analytical data from rounds 1 and 2 as reported in the RI (Warzyn Engineering, Inc. 1988). The analytical data reported in the tables were generated from the analysis of the ground water before bromide was added to the samples; therefore, the bromide concentrations presented in Tables 6 through 8 are actual field bromide concentrations. Tables 3 through 8 do not include less than detection-limit values for both the RI and WES data nor the R, N, and the bracketed numbers from the RI data (R means the data are unusable because quality control criteria were not met, N means that the detection limit exceeded the contract-required detection limit (CRDL) and the associated value is the detection limit, the values in brackets mean that the concentrations were quantified below the CRDL). The tables indicate parameters that were analyzed for, but not detected, during any of the analyses if the analyte in question appears in any of the other analytical rounds (WES or the RI). The concentrations of contaminants found during the WES analyses of the ground-water samples appear to be similar to those reported in the RI (Warzyn Engineering, Inc. 1988). Although some VOA compound loss from the permeants in the reservoir was noted, the losses are considered minimal. Based on the analytical results of the ground-water samples from wells X-1, X-14, and X-25, the permeants used in the permeability testing are representative of the ground water found in the site observation wells during the RI. Therefore, the SB backfill mixture permeability samples were exposed to

approximately the same quality water during laboratory permeability testing that the proposed SB slurry wall will be exposed to based on the results of the analytical data presented in the RI.

Evaluation of the Bentonites

52. The results from the free swell testing of the four bentonite sources are presented in Tables 9 through 12. The tables list the test solutions and the respective free swell volumes for cumulative test times of 0, 2, and 24 hr. The final column of each table presents the percent of control for each solution. The percent of control is a comparative value that is calculated by dividing the free swell volume of the bentonite for each test solution by the free swell volume of the bentonite sample for tap water, then multiplying by 100. The free swell tests for all the bentonites using tap water as the test solution were considered as the control runs.

53. Percent of control values (POCVs) were used to determine the degree of interaction, if any, between the bentonites and test solutions. If a bentonite sample has a POCV less than 100 percent, then adverse interactions between the contaminants in the test solutions and the bentonite are occurring. It is possible to have POCVs greater than 100 percent. Some contaminants, in solution at lower concentrations, may increase the swell capacity of some bentonites. This phenomenon was observed by Hettiaratchi and Hrudey (1987). They concluded that acetone at concentrations of less than 25 mole percentage of acetone (approximately 52 percent by weight solutions) increased the free swell capacity of the SB mixture tested.

54. In a total of seven tests (Table 10), Enviro-Seal had six of seven POCVs greater than 100 percent. Western Bentonite (Table 9) and Saline Seal 100 (Table 11) had four of seven POCVs greater than 100 percent. Finally, Custom Sealant 50 (Table 12) had no POCVs greater than 100 percent.

55. All three acetone concentrations (1,000 mg/ℓ, 3,000 mg/ℓ, and 6,000 mg/ℓ) increased the POCVs for all the bentonites tested except for Custom Sealant 50. MEK increased the POCVs for both Western Bentonite and Enviro-Seal. The POCVs for Saline Seal 100 and Custom Sealant 50 for the MEK tests were 94 and 87 percent, respectively. All of the free swell testing using sodium chloride (salt) as a test solution resulted in POCVs less than or equal to 100 percent for all the bentonites, with the Enviro-Seal 4,000 mg/ℓ

NaCl test having the only POCV equal to 100 percent. Enviro-Seal performed the best with respect to the sodium chloride free swell tests followed closely by the performance of the Western Bentonite. Toluene did not have a significant effect on any of the bentonite samples tested.

56. Some concern was felt that the physical shape and relative surface area of the various bentonite samples may impact the hydration of the respective bentonite layers of each sample because some of the bentonite samples were shipped in the form of small pellets, while some were in the form of a powder. Free swell testing of all bentonites using the high concentrations of acetone and sodium chloride and tap water was performed in which free swell volumes were measured over a 1-week period. Week-long free swell testing was performed in order to insure that differences in the 24-hr free swell volume of the various bentonites were not due to water diffusion rates into the centers of the pellets and powder, but due to actual differences in the interaction between the bentonites and the contaminants in the test solutions.

57. Table 13 presents the relative POCVs for each of the bentonite samples. From Table 13, Enviro-Seal performed best followed closely by Western Bentonite. The only substantial difference between the two was the POCV for the high sodium chloride testing in which Enviro-Seal and Western Bentonite had POCVs of 77 and 67 percent, respectively.

58. A closer evaluation of both Enviro-Seal and Western Bentonite was made which included conversations with an SB slurry wall contractor, Geo-Con Inc., Pittsburgh, PA. Geo-Con indicated that they have had much better results with the non-specialty type bentonites such as Western Bentonite. Bentonite yield is a rough measure of solids content based on the viscosity and swell capacity of the bentonite. A comparison of the yields of Enviro-Seal and Western bentonite indicated that Enviro-Seal is an extremely high-yield bentonite that was developed for use as a liner material for lagoons. Western bentonite, on the other hand, is an average-yield bentonite that is much more suitable for use in formulating bentonite slurries for SB slurry wall construction. Using a high-yield bentonite would make it very difficult to achieve a high enough percentage of bentonite in an SB backfill mixture (a minimum of 1-2 percent bentonite is recommended by the USEPA). Also, a

* Personal Communication, September 1988, Steve Day, Geo-Con, Inc., Pittsburgh, PA.

3-percent slurry of Enviro-Seal was so viscous that Marsh Funnel readings could not be made because the slurry would not flow through the funnel opening. Therefore, Western Bentonite was chosen as the bentonite for use in formulating the SB backfill mixtures.

59. Various ratios of Western Bentonite Gary-Hobart tap water were evaluated. A Marsh Funnel reading of at least 45 sec was the target reading during the formulation of the Western Bentonite slurry. A 6-percent Western Bentonite slurry had a Marsh Funnel reading of 48 sec and was used in the formulation of the two SB backfill mixtures.

Evaluation of the Borrow Materials

60. Results from the geotechnical analysis of the six borrow sources are presented in Appendix B. The sources were categorized in terms of their relative value as a borrow material for use in formulating an SB backfill mixture. The borrow materials were categorized as good, fair, and poor.

61. DR-1 is classified as a CH type clay. A CH type clay is an inorganic clay of high plasticity typically referred to as a "fat" clay. DR-1 was the only CH type soil of the six borrow sources evaluated. The percentage of DR-1 material passing a No. 200 US standard sieve was approximately 86 percent. DR-1 has approximately 60-percent clay fines, which is considered relatively high. A borrow material containing a high percentage of clay fines will produce SB backfill mixtures with extremely low permeabilities (D'Appolonia 1980). Therefore, DR-1 is considered a good borrow material and was used in the formulation of one of the two SB backfill mixtures.

62. SO-1, SM-1, and OL-1 are all very similar CL type soils. A CL type soil is a sandy clay with low to medium plasticity. All of these soils had at least 85 percent of the material pass a No. 200 sieve. These soils also had a significant amount of sand and some gravel present. SM-1 had a higher percentage of clay fines than did SO-1 and OL-1. SM-1, SO-1, and OL-1 were all considered fair borrow materials. SM-1 was considered as the best of the fair group of borrow materials due to its high percentage of clay fines. SO-1 was the second best of the three fair sources and considered representative of that group. Because data were already going to be generated on an SB backfill mixture formulated with a good borrow source, SO-1 was chosen for use in formulating the second SB backfill mixture used in the permeameter testing.

63. Samples IMT-1 and DW-1 were both sandy clay (SC) type soils with relatively low percentages of material passing a No. 200 sieve. Both samples had a larger percentage of sand than the other candidate materials. Therefore, these soils were considered relatively poor for use as a borrow material.

Characterization of the Selected Borrow Materials

64. The results of the geotechnical and chemical analyses of the two selected borrow materials, samples DR and SO, are presented in Table 14. (Note: Samples DR-1 and SO-1 will now be referred to as samples DR and SO.) These tables present the chemical and physical characteristics of the two borrow materials used in formulating the SB backfill mixtures.

Characterization of the SB Backfill Mixtures

65. The Western Bentonite slurry and each borrow material sample were mixed according to the methods discussed in Part III to formulate two SB backfill mixtures which were labelled SB backfill samples DR and SO. The two SB backfill samples were loaded into the permeameters for permeability testing. Samples from both SB backfill mixtures were characterized in terms of their respective geotechnical and chemical properties through a variety of analyses. The results from the geotechnical and chemical analyses of the DR and SO backfill mixtures are presented in Table 15. Both SB backfill mixtures reflect the similar chemical characteristics of the borrow materials used in formulating the mixtures. The SO mixture has high levels of calcium and magnesium due to the elevated levels in the SO borrow material. Water contents of 49.5 and 41.1 percent for samples DR and SO, respectively, were required due to the high liquid limit of the borrow sources. DR and SO mixtures had bentonite percentages of 2.30 and 2.33 percent, respectively, which are higher than the 1-2 percent bentonite recommended (USEPA 1984). DR and SO mixtures had final slumps of 4.0 and 4.5 in.

66. The porosities of each SB backfill mixture were determined by the following equation as presented by Holtz and Kovacs (1981):

$$n = e \times 100 / (1 + e) \tag{1}$$

where

n = sample porosity, percent

e = sample void ratio, dimensionless

67. The void ratios for each SB backfill sample were determined as described in Part III of this report. The void ratios of the DR and SO backfill were 1.514 and 1.293, respectively. The calculated porosities of the DR and SO backfill mixtures are 60.2 percent and 56.4 percent, respectively. Pore volumes were calculated by using the following equation:

$$PV = n \times V_t / 100 \tag{2}$$

where

PV = sample pore volume, ml

n = sample porosity, percent

V_t = bulk volume of sample, ml

68. The pore volumes for each SB backfill mixture were calculated using the average bulk volumes of the samples loaded into the permeameters. The pore volumes of the DR and SO backfill mixtures in the permeameters were 266.3 ml and 249.5 ml, respectively.

Permeameter Testing

Evaluation of permeameter test apparatus

69. An evaluation was made on the permeameter test system to determine the impact of inherent systemic errors. A sensitivity analysis was conducted for the hydraulic conductivity to estimate the effect of measurement errors associated with the permeameter test apparatus. The flow rate through a cell is given by Darcy's equation as

$$Q = K \times A \times H / L \tag{3}$$

where

Q = flow rate through the cell, cm^3/sec

K = hydraulic conductivity, cm/sec

A = cross-sectional area of sample, cm^2

H = pressure head, ft of water

L = length of sample, ft

70. The flow rate (Q) is measured by determining the time required to collect a known volume of permeant in the collection vessel by

$$Q = V / t \tag{4}$$

where

V = volume of permeant collected, cm^3

t = amount of time to collect V, sec

71. For this study, t was approximately 24 hrs or 86,400 sec. Equation 3 is rearranged as

$$K = (V \times L) / (A \times H \times t) \tag{5}$$

The logarithmic derivative of Equation 5 is

$$dK/K = dV/V + dL/L - dt/t - dA/A - dH/H \tag{6}$$

which can be used in the sensitivity analysis for a term such as dV/V (interpreted as the fractional change in the volume). For example, an error of 0.1 cm^3 in reading a volume of 50 cm^3 of permeant can be calculated as presented in Equation 7 below

$$dK/K = -0.1 / 50 = 0.002 \text{ or } 0.2\% \tag{7}$$

72. From Equation 7, the calculated error in the hydraulic conductivity value would be 0.2 percent. Similarly, an error of reading the volume too low by 0.1 cm^3, a negative error, would produce an error of -0.2 percent. The logarithmic derivative terms which have negative signs result in errors having the opposite sign. For example, an error of overestimating time by 1,000 sec (16.6 min) out of a time period of 86,400 sec (1 day) would produce a -1.2 percent error in hydraulic conductivity.

73. Table 16 presents typical values of various control parameters of the permeameter test apparatus and examines the impact of various measurement errors of the control parameters on the calculated hydraulic conductivity value. For simplicity, relative changes in hydraulic conductivity are expressed in percentages in Table 16. The maximum positive or negative error

in hydraulic conductivity may be determined by evaluating the worst combination of errors which would occur when dV and dL are positive (or negative) and dt, dA, and dH are negative (or positive). Then,

$$dK/K = 0.2 + 5.9 + 1.0 + 6.2 + 2.8 = \pm 16.1\ \% \qquad (8)$$

Thus, dK/K should have a measurement error much smaller than ±16.1 percent.

74. The variance of the measurement error for the term dK/K is a combination of the variances of the terms dV/V, dL/L, dt/t, dA/A, and dH/H. The variance (v) of dK/K is then given by

$$v_{dK/K} = v_{dV/V} + v_{dL/L} + v_{dt/t} + v_{dA/A} + v_{dH/H} \qquad (9)$$

75. Each of the standard deviations can be estimated from the values in Table 16 so that

$$v_{dV/V} = (0.002)^2+(0.059)^2+(0.10)^2+(0.062)^2+(0.028)^2 \qquad (10)$$

or $(v_{dK/K})^{0.5}$ = 0.094 (9.4 percent). The statistical interpretation of the result is that the hydraulic conductivity is expected to be measured without error, but errors that occur will affect hydraulic conductivity so that in approximately two-thirds of the measurements, the error will be less than ±9.4 percent.

76. Sample consolidation may affect the stability of the permeability test. It was believed that as the pressure head on the permeameters was increased, consolidation of the samples would occur and thereby decrease the calculated hydraulic conductivity due to the collapse or reduction of some of the interstitial hydraulic passages. Visual observations made during the initial start-up of the permeability test apparatus noted slight movement of the samples inside the permeameter cells as the pressure head was slowly increased. During this period, it was believed that the flow inside the samples was more irregular than it will be at any other time during the test due to the initial consolidation of the samples. However, within a very short time, the flow stabilized and the system became very stable regardless of the pressure head or hydraulic gradient exerted on the system.

77. Appendix C presents plots of the observed hydraulic conductivity for each cell versus the respective hydraulic gradient applied. In a perfect system, hydraulic conductivity (K) should be independent of changes in the hydraulic gradient (i). Therefore, plots such as those presented in Appendix C for a perfect permeameter system, with no consolidation occurring beyond initial consolidation, should be horizontal lines. Most of the i-versus-K plots for the 16 permeameters have a distinct horizontal orientation. During the initial stages of the study, most of the figures indicate that some deviation from a horizontally oriented plot occurred due to the initial consolidation of the samples. However, the hydraulic conductivities were relatively constant at the higher hydraulic gradients, with the higher hydraulic gradients being representative of the bulk of the permeability testing. Based on the results of the sensitivity analysis and the analysis of Appendix C (Figures C1-C16), the permeability test apparatus used for this study is a stable and accurate means for determining the hydraulic conductivity of the SB backfill materials.

78. Permeameter testing results for the two SB backfill mixtures are summarized in Table 17. The permeameters are numerically identified as permeameters 1 through 16. Permeameters 1 through 8 were loaded with the DR backfill mixtures. Permeameters 9 through 16 were loaded with the SO backfill mixtures. In Table 17, the period of permeability testing in which all permeameters were permeated with tap water is identified as phase I and the period of testing in which ground water was used as the permeants is identified as phase II. Table 17 also presents the amount of tap water permeated through each permeameter cell and the number of pore volumes, permeant type, hydraulic conductivity (K) during each phase, and the ratio of the phase II K values to the phase I K values. For the sake of discussion, this ratio will be referred to as the K ratio.

79. The data used in calculating the hydraulic conductivities can be found in Tables 2 and 17, and in Appendix D. The value of H over L is typically referred to as the hydraulic gradient (i) which is listed in Appendix D for each cell. Appendix D also lists the calculated hydraulic conductivities of each test cell and the associated number of pore volumes of permeants permeated through the cell.

80. Figures C17 through C32 present hydraulic conductivity versus number of pore volumes of permeant passed through each of the SB backfill mixture

samples in all 16 permeameters. The figures also differentiate between phase I and phase II for all cells, except the control cells (these cells were permeated with tap water only). Adverse reactions between the SB backfill mixtures and the contaminants in the permeants are observed as a significant increase in hydraulic conductivity. A horizontal plot indicates no chemical interaction between the SB backfill samples and the permeants or no change in system hydraulics, such as wall effects. All of the permeameters, except cell 6, had approximately horizontal orientations. The range of hydraulic conductivities covered on the Y axis of Figures C17 through C32 is very small; therefore, differences between the various K values for each cell are actually relatively small. In order to put the K data into the proper perspective, Figures C33 through C40 present the K data for the replicate cells (both replicate's K values are presented on one figure) with an expanded range for the Y-axis. These figures were developed to give the reader an indication of the relatively small differences in K for each cell over the course of permeability testing.

DR Backfill Mixture Permeameters

DR control permeameters

81. Cells 1 and 2 were the control cells for the DR/backfill mixture. As with all control cells for this study, cells 1 and 2 were permeated only with Gary-Hobart tap water throughout the course of the permeability testing. Figures C17 and C18 present the K-versus-pore volumes of permeant permeated through control cells 1 and 2, respectively. From Table 17, the standard deviations of K during phase I were 9.7E-09 cm/sec and 7.9E-09 cm/sec for cells 1 and 2, respectively. The standard deviations of K during phase II were 6.9E-09 cm/sec and 5.3E-09 cm/sec for cells 1 and 2, respectively, indicating that both cells were more stable during phase II. The average K value for both control cells for the whole study was 3.1E-08 cm/sec.

82. Both control cells experienced a period of variability in K at the initiation of permeability testing. Both cells initially seemed to have a slight gradual decrease in K over time. After the permeation of approximately one pore volume, both cells stabilized. Cell 1 experienced more variation in K over time than did cell 2. Figure C18 indicates that cell 2 did not have a truly horizontal orientation until after approximately two pore volumes were

permeated. The slight downward trend in K values, especially evident in cell 2, could be attributed to both blinding off of some pores in the sample and to continual consolidation of the sample.

DR X-1 permeameters

83. Cells 3 and 4 were permeated with Gary-Hobart tap water for 1.6 and 1.3 pore volumes, then with ground-water samples from site observation well X-1 for 3.7 and 2.2 pore volumes, respectively. Figures C19 and C20 present the K values versus pore volumes of permeant passed through cells 3 and 4, respectively. Much like the control cells, the X-1 cells had erratic K values early into permeability testing with the K becoming relatively constant after 0.5 pore volumes. The average phase I K values for cells 3 and 4 are 3.9E-08 cm/sec and 3.1E-08 cm/sec with standard deviations of 9.6E-09 cm/sec and 1.0E-08 cm/sec, respectively (Table 17). The average phase II K values are 4.1E-08 cm/sec, and 2.5E-09 cm/sec with standard deviations of 1.2E-08 cm/sec and 4.8E-09 cm/sec, respectively. The K ratios for cells 3 and 4 were 1.0 and 0.79, respectively.

84. Cell 3 experienced a brief period of elevated K's at approximately 5.0 pore volumes, but the K very quickly returned to the previous K range and remained there for approximately 0.25 more pore volumes. This short period of elevated K values for cell 3 is believed to be due to operational factors and not chemical interaction between the backfill and contaminants in the ground water.

85. As shown in Figure C20, cell 4 K data had little deviation from the horizontal. Both cells indicated very stable K values after several pore volumes of ground water had permeated through the samples. The K ratios for cells 3 and 4 are 1.0 and 0.8, respectively. There was no apparent increase in the K values of either permeameter during phase II; therefore, the DR backfill mixture is considered compatible with the ground-water samples from observation well X-1.

X-14 DR permeameters

86. Cells 5 and 6 were permeated with Gary-Hobart tap water for approximately 1.3 and 3.2 pore volumes, then 1.7 and 4.2 pore volumes of ground water, respectively. Figures C21 and C22 present the K-versus-pore volumes of permeant passed through cells 5 and 6, respectively. The average phase I K values for cells 5 and 6 were 3.1E-08 cm/sec and 8.7E-08 cm/sec, respectively, with respective standard deviations of 1.1E-08 cm/sec and 8.9E-08 cm/sec

(Table 17). The average phase II K values for cells 5 and 6 were 1.8E-08 cm/sec and 5.2E-07 cm/sec, respectively, with respective standard deviations of 5.6E-09 cm/sec and 4.2E-07 cm/sec. The K ratios for cells 5 and 6 were 0.58 and 5.9, respectively.

87. Figure C22 does not indicate a stable test cell. Initially, cell 6 behaved much like cell 5, the other X-14 replicate cell, but after approximately 0.75 pore volumes of tap water had permeated, the cell became very unstable. The pressure head on cell 6 was turned off after approximately 2.5 pore volumes of tap water had permeated. From past experiences with unstable permeameter cells, reducing the pressure head on an unstable cell allows the sample within the cell to "seal" itself against the cell walls. Unfortunately, this operation did not eliminate the excessive permeation of tap water. The reason for the excessive flow was not known. It was believed to be due either to channelization of the permeants through the sample and/or flow of permeants along the cell wall (sidewall effects). Flow through cell 6 was allowed to continue in hopes that the channels, if that was the cause, would blind off. After 2.5 pore volumes of tap water had permeated, the pressure head was removed. During this period the permeants in the ground-water permeameters were being switched from tap water to ground-water samples. Cell 6 was allowed to remain with no pressure head exerted on it for approximately 1 week, then it was filled with ground water from well X-14. This attempt to eliminate excessive permeant leakage within the cell by allowing the backfill sample in the cell to seal the sidewall channels off by reducing the pressure head on the permeameter seemed to work temporarily. For approximately 0.5 pore volumes, the permeation rate through the cell was very similar to cell 5, but after 0.5 pore volumes of tap water had permeated through the cell, the permeation rate through the cell increased dramatically. It is extremely doubtful that this increase in permeation rate was due to chemical interaction. The cell never recovered. The cause of the increased permeation rate is believed to be increased channelization through the sample with some wall effects. Therefore, the data from cell 6 were not used to evaluate the compatibility of ground-water samples from well X-14 with the DR backfill mixture.

88. Figure C21 is a plot of the cell 5 K data and shows a definite horizontal orientation indicating no appreciable change in K over time. The cell experienced the characteristic inconsistent K values typical of all the

permeameter cells for this study. Approximately 1.3 pore volumes of tap water were permeated through the sample before it was permeated with X-14 ground water (Table 17). The K ratio for cell 5 is 0.6, which is relatively low. However, taking into consideration the high standard deviation for the phase I K values, this value is not surprising. The high degree of K value variability is due to the erratic K's during the early stages of phase I before the cell had stabilized. Based on the K ratio and horizontal orientation of Figure C21, the DR backfill mixture is considered compatible with X-14 groundwater samples.

X-25 DR permeameters

89. Cells 7 and 8 were permeated with Gary-Hobart tap water for approximately 2.7 and 1.9 pore volumes, then ground-water samples from site observation well X-25 for 6.5 and 2.7 pore volumes, respectively. Figures C23 and C24 present K-versus-pore volumes of permeant passed through cells 7 and 8, respectively. The average phase I K values for cells 7 and 8 were 6.3E-08 cm/sec and 4.7E-08 cm/sec, respectively, with the respective standard deviations of K being 3.5E-08 cm/sec and 3.3E-08 cm/sec (Table 17). The average phase II K values for cells 7 and 8 were 1.8E-07 cm/sec and 5.1E-08 cm/sec, respectively, with the respective standard deviations being 1.2E-07 cm/sec and 8.1E-08 cm/sec. The K ratios for cells 7 and 8 were 2.9 and 1.1, respectively.

90. Figures C23 and C24 indicate that both cells 7 and 8 had an initial period of unstable flow that is typical of all permeameters for this study. Atypical of this study was the degree of variability of the K for both cells during phases I and II. Cell 7 had approximately 2.7 pore volumes of tap water permeate before switching to the ground water as the permeant. During the first day of permeating cell 7 with ground water, the K began to become unstable, eventually changing as much as one order of magnitude for one K calculated. Although this deviation in cell 7 K's did occur at the time of the addition of the contaminated ground water, the variability occurred exactly on the day the ground-water sample was added. This indicated that the change in K was associated with the permeant-changing operations and was not due to chemical interaction between the SB backfill mixture and the contaminants. To justify this statement, it must be realized that water immediately added to the permeant reservoir will take approximately 820 hr to completely

replace the clean tap water within the pore spaces of the permeability samples (assuming plug flow).

91. The test plan for this study called for at least two pore volumes of contaminated ground water to be permeated through the test cells. After approximately 4.28 and 2.67 pore volumes of contaminated ground water had permeated through cells 7 and 8, respectively, both cells were turned off and permeameter testing was considered complete for cells 7 and 8. However, during the evaluation of the data, the inconsistency of the K's was noted, the pressure head was restored on both cells, and permeability testing was resumed. Permeability testing was continued to further define whether any trends in K values were developing with either cell. Approximately one additional pore volume of ground-water sample was permeated through each cell.

92. Cell 7 continued to have significantly variable data (K would fluctuate from 1.29E-08 cm/sec to 2.33E-07 cm/sec). The K ratio from Table 17 for cell 7 is 2.9. The K standard deviation for phase II, cell 7 is approximately one order of magnitude higher than the phase I K standard deviation. The phase II data were obviously much more variable than the phase I data; hence the high K ratio. Although the cell 7 K data are variable, all of the calculated K values are within an order of magnitude, and have a horizontal orientation. Therefore, the variability in cell 7 K values is probably due to test variability and not chemical interaction between the DR backfill material and observation well X-25 ground-water samples.

93. Permeameter cell 8 had much less variable K data than cell 7. Only one data point (Figure C24) was significantly higher than the other K values. When the pressure head was restored on cell 8, the K values were slightly less than the range of K values measured prior to the high K value. The K ratio for cell 8 was 1.1, indicating no significant change in the K of the SB backfill material. Therefore, the data from cell 8 indicate compatibility between the backfill mixture and ground water from well X-25.

94. The permeameter test data for cells 7 and 8 did have a significant amount of variation in K values, but, based on the above discussions, ground water samples from site observation well X-25 and the DR backfill mixture are considered compatible.

SO Backfill Mixture Permeameters

SO control permeameters

95. The control cells for the SO backfill mixtures were cells 9 and 10. Approximately 20 and 12 pore volumes of tap water were permeated through cells 9 and 10, respectively (Table 17). Figures C25 and C26 present K-versus-pore volumes of permeant passed through cells 9 and 10. Figures C25 and C26 indicate that both cells 9 and 10 had comparably long periods of unstable flow before stabilizing. The average phase I K values for cells 9 and 10 were 5.5E-07 cm/sec and 2.4E-07 cm/sec, respectively, with respective standard deviations of 4.3E-07 cm/sec and 8.2E-08 cm/sec (Table 17). The average phase II K values for cells 9 and 10 were 2.2E-07 cm/sec and 1.3E-07 cm/sec, respectively, with respective standard deviations of 8.2E-08 cm/sec and 3.6E-08 cm/sec.

96. From Figures C25 and C26, it is apparent that both cells were dynamic during phase I, and during phase II both cells stabilized with consistent K values. The average K for both cells during phase II was 2.2E-08 cm/sec. Due to the unstable flow during Phase I, the K ratios for cells 9 and 10 were 0.4 and 0.5, respectively.

97. Cells 9 and 10 took longer than any of the other 14 permeameters to stabilize. Once both cells stabilized, their respective K values became very constant.

98. Several operational factors and/or systemic conditions could be responsible for the high K value variation. One type of operational factor that could contribute to K value variability is permeant change-out operations. Removing the pressure head from the system could be "flexing" the pores within the SB backfill mixture samples inside the permeameters, causing the internal hydraulic flow system in the samples to change. This change can result in a decrease or increase in K. The pressure was removed approximately four times for each cell. Both cells 7 and 8 had significant increases in K when the pressure heads on the cells were removed and then reapplied. The on/off cycling of the pressure head is believed to contribute to K variability. Another operational factor affecting K variability could be slight differences in the bulk densities of the samples loaded into each cell. Extreme care was taken to insure homogeneity of permeability samples, but realistically there were no two samples in the permeameters exactly alike. Unlike

samples would have differing degrees of consolidation that affect the relative porosities of the samples and in turn affect the observed K for each sample.

X-1 SO permeameters

99. Cells 11 and 12 were permeated with Gary-Hobart tap water for approximately 4.9 and 4.4 pore volumes, respectively. They were then permeated with ground-water samples from site observation well X-1 for approximately 10.3 and 6.1 pore volumes. Figures C27 and C28 present K-versus-pore volumes of permeants permeated through cells 11 and 12, respectively. The average phase I K values were 2.1E-07 cm/sec and 1.9E-07 cm/sec, respectively, with respective standard deviations of 7.5E-08 cm/sec and 9.8E-08 cm/sec (Table 17). The average phase II K values were 2.6E-07 cm/sec and 1.6E-07 cm/sec, respectively, with respective standard deviations of 9.6E-08 cm/sec and 3.2E-08 cm/sec. The K ratios were 1.2 and 0.82 for cells 11 and 12, respectively.

100. Both cells exhibited an initial period of K variability for approximately 2.0 pore volumes. After the initial period of inconsistent K values, both cells stabilized, producing very consistent K values until the end of testing, at which time the cells behaved differently. Cell 11 had very erratic and somewhat elevated K values. On the other hand, cell 12 at approximately the same time had a slight upward trend in K for a short period of time before returning to the range of K values the cell exhibited during the 6.0 pore volumes of very consistent K values. Both cells had an approximate period of 6.0 pore volumes in which the K values were extremely consistent. The K ratios indicate no significant increase in K for both SB backfill samples. Therefore, SO backfill material is considered compatible with ground-water samples from site observation well X-1.

SO X-14 permeameters

101. Cells 13 and 14 were permeated with Gary-Hobart tap water for 5.0 and 4.9 pore volumes, respectively. They were then permeated with site observation well X-14 ground-water samples for 6.2 and 8.6 pore volumes, respectively. Figures C29 and C30 present K-versus-pore volumes of permeant passed through cells 13 and 14, respectively. The average phase I K values for cells 13 and 14 were 2.6E-07 cm/sec and 2.2E-07 cm/sec, respectively, with respective standard deviations of 3.0E-07 cm/sec and 1.2E-07 cm/sec (Table 17). The average phase II K values were 1.6E-07 cm/sec and 2.3E-07 cm/sec for cells 13 and 14, respectively, with respective standard deviations

of 1.2E-07 cm/sec and 1.8E-07 cm/sec. The K ratios for cells 13 and 14 were 0.61 and 1.1, respectively.

102. Cell 13 exhibited a high degree of K variability at the initiation of permeability testing. Approximately 2.5 pore volumes of tap water permeated through cell 13 before the cell stabilized. After approximately 2.0 pore volumes of ground water had permeated, cell 13 experienced an increase in K. This increase in K continued until a third pore volume of permeant had passed. At this time, the pressure head was removed and testing was considered complete. During the evaluation of the data, an upward trend in K was observed and the pressure head was restored to determine if the upward trend in K would continue. From Figure C29, it is apparent that K returned to the previous range, indicating that the increased K values were due to systemic reasons and not chemical interaction between the SB backfill mixture and the contaminants in the ground water. Cell 13 was permeated with an additional 3.0 pore volumes of ground water to insure that no increase in K would occur.

103. Cell 14 behaved somewhat differently than did cell 13 at the initiation of permeameter testing. From Figure C30, it is apparent that cell 14 K values were relatively constant up until the 8.5 pore volume increment at which time K increased by approximately one order of magnitude. This apparent increase in K for cell 14 occurred on the same day as did the maximum K for cell 13. After the high K value, cell 14 K values decreased until they came within the general range of the K values before the elevated K value occurred.

104. Both cells 13 and 14 experienced some variation in K with a sudden increase in K occurring on exactly the same day. The increased K's for both cells indicate that systemic influences due to permeameter operation were the probable cause and not chemical interaction. Therefore, the ground-water sample from site observation well X-14 is considered compatible with the SO backfill mixture.

SO X-25 permeameters

105. Cells 15 and 16 were permeated with Gary-Hobart tap water for 5.1 and 5.7 pore volumes and with ground-water samples from site observation well X-25 for 6.1 and 5.7 pore volumes, respectively. Figures C31 and C32 present the K-versus-pore volumes of permeant passed through cells 15 and 16, respectively. The average phase I K values were 1.9E-07 cm/sec and 2.0E-07 cm/sec for cells 15 and 16, respectively, with respective standard deviations of

1.0E-07cm/sec and 7.7E-08 cm/sec (Table 17). The average phase II K values were 1.4E-07 cm/sec and 1.5E-07 cm/sec, respectively, with respective standard deviations being 7.1E-08 cm/sec and 3.5E-08 cm/sec. The K ratios were 0.74 and 0.73 for cells 15 and 16, respectively.

106. It is apparent from Figures C31 and C32 that both cells experienced K variability at the initiation of permeability testing that was characteristic of all the cells for this study. Cells 15 and 16 indicated stability throughout the course of this study. Both cells had constant K with a slight downward orientation; hence the lower than unity K ratios. This slight downward trend indicated gradual sample consolidation over the course of this study. Phase I and II data indicated very consistent and reproducible data. Therefore, X-25 ground-water samples are considered to be compatible with the SO backfill mixture.

Analysis of Permeants

107. The results of the analysis of the test permeants that were collected after permeating through each of the cells are presented in Tables 18 and 19. These tables list the cell influent and effluent contaminant concentrations, cell number, and respective pore volumes associated with each analysis. The pore volumes listed are the integrated number of pore volumes permeated through each cell and not the number of pore volumes permeated on the final day of sample collection for that set of analysis.

108. Most of the backfill specimens exhibited some adsorptive capacity for the TOC in the permeants. This was especially evident for the well X-14 and X-25 data, which had significantly higher influent TOC concentrations. Adsorption of the TOC is not surprising because organics are known to have a strong affinity to clay-like substances such as silicates and materials containing high percentages of clay.

109. The calcium, magnesium, and sodium data indicate that little desorption/adsorption of cations was occurring between the SB backfill mixtures and the permeants. Therefore, the SB backfill mixtures should have exhibited little or no change in swell volume due to cation substitution. The hydraulic permeability data support this statement by indicating a relatively stable hydraulic conductivity for most of the cells throughout the course of permeability testing.

110. Tables 18 and 19 indicate that chloride and bromide behaved very similarly to the cations. A bromide tracer was used to monitor the hydrodynamic dispersion characteristics of the SB backfill samples during permeability testing. Bromide tends not to react with soil particles or contaminants in the soil matrix as it is negatively charged. Chloride is often the ion of choice in tracer studies; however, it was not suitable in the present study because some of the site ground water contains high concentrations of chloride.

111. The bromide data were somewhat scattered due to the limited amount of bromide analysis performed on the permeants. Only one sample from the permeameter influent permeants was analyzed for bromide (as was the case for all the permeant analysis). Limiting analysis to a single sample was done as a cost-saving measure. The sample used for bromide analysis was taken from one of the several sample jugs sent to WES. The sample used for bromide analysis did not seem to be representative of all the permeant samples used in the permeameter tests. General permeation trends can be deduced from the data based on the data presented in Tables 18 and 19. The permeameters seem to mimic plug flow dynamics with some degree of permeant mixing occurring within the permeameter samples. This is evident with the permeant bromide concentrations still lower than influent concentrations after two pore volumes of permeant had flowed through the samples. This lag effect is indicative of real ground-water systems that are somewhat plug flow, with back-mixing and short-circuiting occurring.

112. Generally speaking, the bromide data indicate that little or no reaction occurred between the inorganic contaminants in the permeants and the two SB backfill mixtures. As mentioned earlier, some degree of TOC sorption was occurring. This is not surprising, when taking into account the affinity TOC has for silicates.

PART V: CONCLUSIONS

113. Based on the results of this study, the following conclusions are made.

a. Chemical analysis of the ground-water samples used in the permeameter study indicated that the primary contaminant concentrations measured in the test permeants were similar to those measured during the RI. Although some loss of volatile contaminants was noted, the concentrations of contaminants in the test permeants were considered to be representative of actual site ground water.

b. The Plexiglas used in the construction of the permeameter components was found to be compatible with the contaminants found in the ground water during Plexiglas/contaminated water compatibility testing. This testing was performed to insure Plexiglas would not degrade when it contacts the site contaminants during permeameter testing.

c. Western Bentonite was chosen as the bentonite source used in preparing the bentonite slurry.

d. All of the bentonite samples, except Custom Sealant 50, exhibited an increase in free swell volume during the acetone free swell tests when compared with the control free swell test results.

e. Western Bentonite and Enviro-Seal had increased free swell volumes when exposed to MEK during the free swell tests. Saline Seal 100 and Custom Sealant 50 both exhibited reduced free volumes when exposed to MEK.

f. Sodium chloride reduced the free swell volumes of all the bentonite samples.

g. Toluene, at the concentration tested, did not have a significant impact on the free swell volumes of any of the bentonite samples.

h. Of the six borrow sources evaluated (Table 1), the DR borrow material was considered a relatively good borrow source based on the geotechnical analyses and was chosen for use in formulating one of the two SB backfill mixtures. The SO, SM, and OL were considered fair borrow sources. Borrow sample SO was chosen for use in formulating the second of the two SB backfill mixtures because it was considered representative of the fair group of borrow sources. The DW and IMT borrow materials were considered to be relatively poor borrow sources.

i. Sensitivity analysis of the permeameter testing apparatus indicates that two-thirds of the test parameter measurements made during permeability testing have an estimated error of ±9.4 percent when calculating hydraulic conductivity associated with them. The maximum error in calculating hydraulic conductivity associated with measuring test parameters during permeameter testing was estimated to be ±16.1 percent.

j. The hydraulic conductivity for most of the test cells seemed to be independent of hydraulic gradient, thereby indicating that for a majority of the samples, consolidation was completed during the initial stages of permeability testing.

k. The DR and SO backfill mixtures were compatible with groundwater samples from site wells X-1, X-14, and X-25.

l. The SB backfill mixtures exhibited an adsorptive capacity for TOC in the permeants, with little interaction observed between the cations in the permeants and the SB backfill mixtures.

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Table 1

List of Borrow Material Vendors

Sample Code	Source
IMT	IMT, Inc. Lindbergh St. Griffith, IN 219-924-7175
SO	Sohacki Transporters 1420 East 89th St. Merrillville, IN 219-769-4737
DR	Brown, Inc. 720 West US-20 Michigan City, IN 219-872-8618
DW	Leo J. DeWolfe, Inc. County 450 East/250 North Valparaiso, IN 219-464-8645
SM	Samocki Bros., Inc. 5030 Industrial Hwy Gary, IN 219-949-7980
OL	Orthyl Lyles, Inc. No Address on Record 219-944-7877

Table 2

Permeameter Test Runs

Permeameter Number	Backfill Sample	Permeant	Cross-sectional ft^2	Sample Length ft	Maximum Hydraulic Gradient*
1	DR	tap water	0.085	0.185	44
2	DR	tap water	0.085	0.185	44
3	DR	X-1	0.085	0.185	44
4	DR	X-1	0.085	0.185	44
5	DR	X-14	0.085	0.185	47
6	DR	X-14	0.085	0.185	47
7	DR	X-25	0.085	0.185	48
8	DR	X-25	0.085	0.185	48
9	SO	tap water	0.085	0.185	27
10	SO	tap water	0.085	0.185	27
11	SO	X-1	0.085	0.185	25
12	SO	X-1	0.085	0.185	25
13	SO	X-14	0.085	0.185	26
14	SO	X-14	0.085	0.185	26
15	SO	X-25	0.085	0.185	29
16	SO	X-25	0.085	0.185	29

* Maximum hydraulic gradient (i) applied

Table 3

Ninth Avenue Ground Water Well X-1

Organic Analysis Data*

Analyte	WES Analysis Jan 13	WES Analysis Feb 24 DR	WES Analysis Feb 24 SO	RI/FS Analysis Dec 1986 Round 1	RI/FS Analysis June 1987 Round 2
Acetone	ND	0.3	0.4	0.1 [B,UJ]	30.0 [B]
Bis(2-ethylhexyl) phthalate	0.02 [B]	NA	NA	ND	ND
Methylene chloride	ND	1.1 [B]	0.8 [B]	ND	0.01 [UJ]
Total organic carbon	4.4	NA	NA	106.5	161.0

* Concentrations in mg/ℓ

Note: ND = not detected; B = detected in blank as well as sample;
UJ = associated numerical value is estimated quantitation limit;
NA = not analyzed for.

Table 4

Ninth Avenue Ground Water Well X-14

Organic Analysis Data*

Analyte	WES Analysis Jan 13	WES Analysis Feb 24 DR	WES Analysis Feb 24 SO	RI/FS Analysis Dec 1986 Round 1	RI/FS Analysis June 1987 Round 2
Benzoic acid	ND	NA	NA	1.0	ND
2-butanone	23.3 UJ	71.0	54.0	45.0*	20.0*
2,4-dimethylphenol	6.9	NA	NA	3.9	ND
Ethylbenzene	ND	ND	ND	2.4 J	2.9
4-Methyl-2-pentanone	480.0	300.0	280.0	5.4 J	ND
Methylene chloride	25.0 B	23.0 B	20.0 B	2.0 J	29.0 B
2-Methylnaphthalene	ND	NA	NA	4.4 J	0.9
2-Methylphenol	3.7	NA	NA	2.2	2.4
4-Methylphenol	8.9	NA	NA	16.0	11.0
Naphthalene	ND	NA	NA	0.4	0.5
Phenol	8.4	NA	NA	ND	2.2
Toluene	132.0	12.0	33.0	83.0	90.0
Trans-1, 2-dichloroethene	ND	ND	ND	ND	3.9
T-xylene	7.3	ND	ND	13.0 J	7.8
Total organic carbon	1,764.0	NA	NA	1,304.8	749.0

* Concentrations in mg/ℓ.

Note: ND = not detected; NA = not analyzed for; UJ = associated numerical value is estimated quantitation limit; J = numerical value is estimated because quality control criteria were not met; B = detected in blank as well as sample.

Table 5

Ninth Avenue Ground Water Well X-25

Organic Analysis Data*

Analyte	WES Analysis Jan 13	WES Analysis Feb 24 DR	WES Analysis Feb 24 SO	RI/FS Analysis Dec 1986 Round 1	RI/FS Analysis June 1987 Round 2
Acetone	ND[@]	92.0	85.0	450.0[B]	660.0[UJ]
Benzoic acid	ND	NA	NA	13.0	ND
2-butanone	1,300.0	1,550.0	1,390.0	1,800.0[B]	2,100.0[J]
4-methyl-2-pentanone	107.0	130.0	88.0	140.0	ND
2-methylphenol	ND	NA	NA	1.1	1.2[J]
4-methylphenol	1.3	NA	NA	2.9	6.6[J]
Methylene chloride	20.0[B]	17.0[B]	14.0[B]	14.0	30.0[J]
Phenol	0.8	130.0	88.0	1.5	ND
Toluene	3.7[UJ]	2.9	ND	7.1[B,J]	ND
Total organic carbon	2,970.0	1,550.0	1,390.0	4,998.0	569.0

* Concentrations in mg/ℓ.

Note: ND = not detected; @ = detection limit was 100 mg/ℓ due to 2-butanone interference; B = detected in blank as well as sample; UJ = associated numerical value is estimated quantitation limit; NA = not analyzed for; J = numerical value is estimated because quality control criteria were not met.

Table 6

Ninth Avenue Ground Water Well X-1

Inorganic Analysis Data *

Analyte	WES Analysis Jan 13	RI/FS Analysis Dec 1986 Round 1	RI/FS Analysis June 1987 Round 2
Ammonia	NA	11.2	23.6
Bromide	135.0	NA	NA
Chloride	22,700.0	20,000.0	16,277.0
Fluoride	0.1	0.1	ND
Kjeldahl nitrogen	NA	11.8 J	6.4
Nitrate	NA	NA	1.4
Sulfate	373.0	28.3	320.0
Sulfide	NA	NA	0.1
Biochemical oxygen demand	NA	9.0	6.0 J
Chemical oxygen demand	NA	700.0	729.8
Suspended solids	NA	187.0	175.0
Conductivity	36,000.0	NA	NA
Hardness	2,480.0	NA	NA
Alkalinity	429.0	550.0	545.0
pH	7.5	NA	NA
Oil & grease	NA	982.8	ND
Aluminum	0.3	ND	0.2
Arsenic	0.01	ND	ND
Barium	0.4	ND	3.0
Boron	0.4	NA	NA
Cadmium	0.0003	ND	ND
Calcium	992.0	504.0	631.0

(Continued)

* Concentrations in mg/ℓ.

Note: NA = not analyzed for; ND = not detected; J = numerical value is estimated because quality control criteria were not met.

Table 6 (Concluded)

Analyte	WES Analysis Jan 13	RI/FS Analysis Dec 1986 Round 1	June 1987 Round 2
Chromium	0.02	0.4	ND
Iron	18.8	28.9[J]	32.4
Lead	0.5	0.4[UJ]	ND
Magnesium	217.0	118.0	134.0
Manganese	1.5	1.4	1.3
Nickel	0.01	ND	ND
Potassium	35.7	10.6[J]	ND
Selenium	0.04	ND	ND
Silica	9.2	NA	NA
Sodium	13,000.0	9,120.0	10,300.0
Vanadium	0.1	ND	ND
Zinc	62.5	10.4	10.8[J]

Note: ND = not detected; J = numerical value is estimated because quality control criteria were not met; UJ = associated numerical value is estimated quantitation limit.

Table 7

Ninth Avenue Ground Water Well X-14

Inorganic Analysis Data*

Analyte	WES Analysis Jan 13	RI/FS Analysis Dec 1986 Round 1	RI/FS Analysis June 1987 Round 2
Ammonia	NA	58.8	179.3
Bromide	170.0	NA	NA
Chloride	1,450.0	150.0[J]	147.0
Fluoride	3.4	NA	ND
Kjeldahl nitrogen	NA	58.0	17.6
Nitrate	NA	0.5	1.6
Phosphate	NA	0.5	0.1
Sulfide	NA	NA	0.1
Sulfate	1,045.0	366.0	57.2
Biochemical oxygen demand	NA	3,437.0	4,386.0[J]
Chemical oxygen demand	NA	2,080.0	6,671.0
Suspended solids	NA	2,020.0	606.0
Conductivity	3,100.0	NA	NA
Hardness	2,760.0	NA	NA
Alkalinity	403.0	1,200.0	1,230.0
pH	5.8	NA	NA
Oil & grease	NA	279.8	ND
Aluminum	0.4	ND	ND
Antimony	ND	0.1	ND
Arsenic	0.008	ND	ND
Barium	0.1	ND	ND
Beryllium	0.01	ND	ND
Boron	1.2	NA	NA

(Continued)

* Concentrations in mg/ℓ.

Note: NA = not analyzed for; J = numerical value is estimated because quality control criteria were not met; ND = not detected.

Table 7 (Concluded)

Analyte	WES Analysis Jan 13	RI/FS Analysis Dec 1986 Round 1	RI/FS Analysis June 1987 Round 2
Cadmium	0.0002	0.1^{J}	0.01
Calcium	1,040.0	877.0	574.0
Chromium	0.1	0.1	0.1
Cobalt	0.1	ND	ND
Iron	323.0	232.0	67.0
Lead	0.2	ND	ND
Magnesium	180.0	182.0	117.0
Manganese	4.8	4.9	4.5
Nickel	0.05	0.3	0.1
Potassium	23.1	17.6	214.0^{J}
Silica	35.4	NA	NA
Sodium	47.4	19.4	14.7
Vanadium	0.1	ND	ND
Zinc	2.5	3.6	0.1^{J}

Note: J = numerical value is estimated because quality control criteria were not met; ND = not detected; NA = not analyzed for.

Table 8

Ninth Avenue Ground Water Well X-25

Inorganic Analysis Data*

Analyte	WES Analysis Jan 13	RI/FS Analysis Dec 1986 Round 1	RI/FS Analysis June 1987 Round 2
Ammonia	NA	260.0	13.8
Bromide	28.4	NA	NA
Chloride	1,200.0	1,050.0	1,134.0
Fluoride	9.3	NA	ND
Kjeldahl nitrogen	NA	236.0	218.0
Nitrate	NA	ND	0.4
Phosphate	NA	0.1	0.4
Sulfate	396.0	15.4	44.2
Sulfide	NA	NA	0.4
Alkalinity	578.0	3,050.0	3,850.0
Biochemical oxygen demand	NA	768.0	2,718.0 J
Chemical oxygen demand	NA	9,320.0	15,889.0
Suspended solids	NA	208.0	778.0
Conductivity	27,000.0	NA	NA
Hardness	3,440.0	NA	NA
pH	6.8	NA	NA
Oil & grease	NA	7.1	21.3 J
Aluminum	2.8	ND	1,040.0
Arsenic	0.02	ND	ND
Barium	0.3	ND	0.7
Beryllium	0.005	ND	ND
Boron	3.8	NA	NA
Cadmium	0.001	0.1 J	ND

(Continued)

* Concentrations in mg/ℓ.

Note: NA = not analyzed for; ND = not detected; J = numerical value is estimated because quality control criteria were not met.

Table 8 (Concluded)

Analyte	WES Analysis Jan 13	RI/FS Analysis Dec 1986 Round 1	RI/FS Analysis June 1987 Round 2
Calcium	836.0	762.0	717.0
Chromium	0.1	0.2	0.2
Cobalt	0.1	ND	ND
Iron	103.0	13.3	16.5
Lead	0.03	ND	ND
Magnesium	574.0	701.0	591.0
Manganese	17.6	12.9	15.0
Nickel	1.2	2.3	1.9
Potassium	34.0	ND	ND
Silica	27.5	NA	NA
Sodium	656.0	797.0	716.0
Vanadium	0.6	1.2	0.8
Zinc	1.4	0.3	0.2[J]

Note: ND = not detected; NA = not analyzed for; J = numerical value is estimated because quality control criteria were not met.

Table 9

Free Swell Data for Western Bentonite

Contaminant (concentration)	Time hr	Free Swell Volume* ml	Percent of Control**
Acetone (1,000 mg/ℓ)	0	2.2	
	2	27.3	
	24	33.5	114
Acetone (3,000 mg/ℓ)	0	2.2	
	2	30.0	
	24	32.7	112
Acetone (6,000 mg/ℓ)	0	2.2	
	2	27.0	
	24	34.2	117
MEK (3,000 mg/ℓ)	0	2.2	
	2	27.8	
	24	32.0	109
NaCl (4,000 mg/ℓ)	0	2.2	
	2	26.3	
	24	27.9	92
NaCl (10,000 mg/ℓ)	0	2.2	
	2	18.8	
	24	19.6	67
Toluene (200 mg/ℓ)	0	2.2	
	2	23.3	
	24	28.9	99
Tap water† (uncontaminated)	0	2.2	
	2	25.3	
	24	29.3	100

* Values shown are the mean of three replicates.
** Test free swell volume/control free swell volume x 100.
† Test control.

Table 10

Free Swell Test Data for Enviro-Seal

Contaminant (concentration)	Time hr	Free Swell Volume* ml	Percent of Control**
Acetone (1,000 mg/ℓ)	0	2.1	
	2	34.8	
	24	35.9	121
Acetone (3,000 mg/ℓ)	0	2.1	
	2	29.0	
	24	31.1	105
Acetone (6,000 mg/ℓ)	0	2.1	
	2	30.3	
	24	31.8	107
MEK (3,000 mg/ℓ)	0	2.1	
	2	31.3	
	24	33.3	112
NaCl (4,000 mg/ℓ)	0	2.1	
	2	28.6	
	24	29.8	100
NaCl (10,000 mg/ℓ)	0	2.1	
	2	21.4	
	24	22.8	77
Toluene (200 mg/ℓ)	0	2.1	
	2	29.7	
	24	32.1	108
Vicksburg tap water† (uncontaminated)	0	2.1	
	2	27.8	
	24	29.7	100

* Values shown are the mean of three replicates.
** Test free swell volume/control free swell volume x 100.
† Test control.

Table 11

Free Swell Test Data for Saline Seal 100

Contaminant (concentration)	Time hr	Free Swell Volume* ml	Percent of Control**
Acetone (1,000 mg/ℓ)	0	1.7	
	2	34.6	
	24	36.4	121
Acetone (3,000 mg/ℓ)	0	1.7	
	2	30.9	
	24	31.9	106
Acetone (6,000 mg/ℓ)	0	1.7	
	2	31.3	
	24	32.1	106
MEK (3,000 mg/ℓ)	0	1.7	
	2	27.6	
	24	28.5	94
NaCl (4,000 mg/ℓ)	0	1.7	
	2	23.5	
	24	24.8	82
NaCl (10,000 mg/ℓ)	0	1.7	
	2	15.6	
	24	16.9	56
Toluene (200 mg/ℓ)	0	1.7	
	2	30.6	
	24	32.4	107
Vicksburg tap water† (uncontaminated)	0	1.7	
	2	29.7	
	24	30.3	100

* Values shown are the mean of three replicates.

** Test free swell volume/control free swell volume x 100.

† Test control.

Table 12

Free Swell Test Data for Custom Sealant 50

Contaminant (concentration)	Time hr	Free Swell Volume* ml	Percent of Control**
Acetone (1,000 mg/ℓ)	0	1.7	
	2	31.9	
	24	32.9	95
Acetone (3,000 mg/ℓ)	0	1.7	
	2	27.9	
	24	30.2	87
Acetone (6,000 mg/ℓ)	0	1.7	
	2	32.7	
	24	34.1	99
MEK (3,000 mg/ℓ)	0	1.7	
	2	28.9	
	24	30.2	87
NaCl (4,000 mg/ℓ)	0	1.7	
	2	25.8	
	24	26.5	77
NaCl (10,000 mg/ℓ)	0	1.7	
	2	17.3	
	24	18.3	53
Toluene (200 mg/ℓ)	0	1.7	
	2	33.0	
	24	34.3	99
Vicksburg tap water† (uncontaminated)	0	1.7	
	2	34.1	
	24	34.6	100

* Values shown are the mean of three replicates.
** Test free swell volume/control free swell volume x 100.
† Test control.

Table 13

Summary of Percentage of Controls for Bentonite Sources

Contaminant (Concentration)	Western Bentonite	Enviro-Seal	Saline Seal 100	Custom Sealant 50
Acetone (1,000 mg/ℓ)	114	121	121	95
Acetone (3,000 mg/ℓ)	112	105	106	87
Acetone (6,000 mg/ℓ)	117	107	106	99
MEK (3,000 mg/ℓ)	109	112	94	87
NaCl (4,000 mg/ℓ)	92	100	82	77
NaCl (10,000 mg/ℓ)	67	77	56	53
Toluene (200 mg/ℓ)	99	108	107	99

Table 14

Physical and Chemical Characterization of Selected Borrow Materials

Parameter	Clay Samples	
	DR-1	SO-1
pH	5.37	7.71
CEC (meq/kg)*	2,260.00	1,960.00
Ca (mg/ℓ)	15,200.00	1,270.00
Mg (mg/ℓ)	9,970.00	5,470.00
K (mg/ℓ)	3,690.00	4,120.00
Na (mg/ℓ)	246.00	149.00
TOC (mg/ℓ)	4,307.00	1,081.00
Liquid limit (%)	50.00	39.00
Plastic limit (%)	17.00	17.00
Plasticity index (%)	33.00	22.00
Water content (%)	15.60	8.00
Specific gravity	2.73	2.73
Clay type**	CH	CL

* Method 9081, SW-846, sodium method (USEPA 1986).
** Unified Soil Classification System method.

Table 15

Physical and Chemical Characterization of SB Backfill Permeability Samples

Parameter	SB Backfill Samples	
	DR-1	SO-2
pH	6.190	8.130
CEC (meq/kg)*	2,640.000	1,840.000
Ca (mg/ℓ)	1,679.000	20,488.000
Mg (mg/ℓ)	5,688.000	12,493.000
K (mg/ℓ)	3,948.000	4,447.000
Na (mg/ℓ)	373.000	429.000
TOC (mg/ℓ)	7,015.000	9,896.000
Liquid limit (%)	49.000	42.000
Plastic limit (%)	18.000	17.000
Plasticity index (%)	31.000	25.000
Water content (%)	49.500	41.100
Specific gravity	2.735	2.740
Void ratio (e)	1.514	1.293
Porosity (n)	0.602	0.564
% Bentonite	2.300	2.330
Slump (in.)	4.000	4.500

* Method 9081, SW-846, sodium method (USEPA 1986).

Table 16

Sensitivity Analysis for Hydraulic Conductivity

Control Parameter	Relative Change				
	dV cm3	dL ft	dt sec	dA cm2	dH ft
Volume, 50 cm^3	±0.1				
Sample length, 0.17 ft		±0.01			
Time, 86,400 sec			±900		
Area, 81.07 cm^2				±5.0	
Head, 8.0745 ft H_2O					±0.23
dK/K, (± percent)	0.2	5.9	1.0	6.2	2.8

Table 17

Summary of Preliminary Permeameter Results

Permeameter Number	Phase I* Permeant	Number of Pore Volumes Permeated During Phase I	Average K During Phase I cm/sec	Phase I K Standard Dev. cm/sec	Phase II** Permeant	Number of Pore Volumes Permeated During Phase II	Average K During Phase II cm/sec	Phase II K Standard Dev. cm/sec	Ratio Phase II to Phase I K†
DR Backfill									
1	Tap water	1.33	3.07E-08	9.73E-09	Tap water	2.60	2.48E-08	6.93E-09	0.80
2	Tap water	1.73	3.90E-08	7.92E-09	Tap water	3.48	3.02E-08	5.32E-09	0.77
3	Tap water	1.56	3.94E-08	9.62E-09	X-1	3.71	4.08E-08	1.24E-08	1.03
4	Tap water	1.27	3.09E-08	1.02E-09	X-1	2.16	2.45E-08	4.80E-09	0.79
5	Tap water	1.27	3.13E-08	1.06E-08	X-14	1.68	1.81E-08	5.59E-09	0.58
6	Tap water	3.21	8.67E-08	8.98E-08	X-14	4.11	5.17E-07	4.15E-07	5.96
7	Tap water	2.72	6.34E-08	3.54E-08	X-25	6.48	1.84E-07	1.15E-07	2.90
8	Tap water	1.87	4.67E-08	3.29E-08	X-25	2.73	5.12E-08	8.12E-08	1.10
So Backfill									
9	Tap water	10.81	5.47E-07	4.26E-07	Tap water	9.33	2.22E-08	8.16E-08	0.04
10	Tap water	5.94	2.39E-07	1.56E-07	Tap water	6.25	1.27E-07	3.64E-08	0.53
11	Tap water	4.94	2.13E-07	7.52E-08	X-1	10.27	2.55E-07	9.64E-08	1.20
12	Tap water	4.43	1.90E-07	9.81E-08	X-1	6.09	1.55E-07	3.23E-08	0.82
13	Tap water	5.02	2.61E-07	3.02E-07	X-14	6.23	1.58E-07	1.17E-07	0.61
14	Tap water	4.88	2.15E-07	1.23E-07	X-14	8.64	2.26E-07	1.78E-07	1.05
15	Tap water	5.07	1.87E-07	1.02E-07	X-25	6.09	1.38E-07	7.08E-08	0.74
16	Tap water	5.66	2.03E-07	7.70E-08	X-25	5.73	1.49E-07	3.45E-08	0.73

* In phase I, all permeants were tap water.
** In phase II, contaminated permeants were run in non-control test cells.
† Calculated using average K's.

Table 18

DR Cells Permeant Chemical Analysis Data

	Cell No.	Pore Volume	Bromide ppm	Chloride ppm	TOC ppm	Calcium ppm	Magnesium ppm	Sodium ppm
				Control Cells				
Influent			NA	NA	NA	NA	NA	NA
Effluent	1	0.65	0.3	20.6	7.8	34.4	17.8	158.0
		1.25	0.6	28.5	6.5	17.1	8.9	124.0
		1.65		13.6	4.0	12.2	6.2	78.3
	2	0.85	0.4	21.3	8.8	31.2	15.4	145.0
		1.45	BDL	24.6	5.9	14.1	7.5	92.7
		2.20	BDL	13.1	3.3	10.5	5.4	61.8
				Well X-1				
Influent			135.0	22,700.0	4.4	992.0	217.0	13,000.0
Effluent	3	0.80	0.5	25.1	11.2	38.1	16.6	145.0
		1.40	86.8	3,660.0	13.1	495.0	254.0	1,230.0
		2.15	228.0	25,500.0	3.1	1,060.0	319.0	11,800.0
	4	0.65	0.5	25.2	7.9	39.0	19.5	164.0
		1.15	97.6	2,150.0	2.4	295.0	164.0	631.0
		1.70	184.0	18,200.0	5.2	1,160.0	433.0	8,420.0
				Well X -14				
Influent			170.0	1,450.0	1,764.0	1,040.0	180.0	47.4
Effluent	5	0.65	0.5	23.9	5.7	34.3	15.5	150.0
		1.15	50.0	NA	23.4	21.3	12.9	102.0
		1.40	108.0	NA	NA	364.0	235.0	1,228.0
	6	1.60	0.4	14.2	4.0	15.8	7.6	62.2
		2.40	118.0	188.0	1,240.8	519.0	119.0	64.0
		3.65	159.0	399.0	2,013.0	891.0	188.0	96.6
				Well X-25				
Influent			28.4	1,200.0	2,970.0	836.0	574.0	656.0
Effluent	7	1.35	0.4	18.8	11.0	33.0	15.8	146.0
		2.00	85.5	808.0	2,005.0	497.0	332.0	491.0
		3.80	177.0	1,090.0	1,224.0	70.6	375.0	649.0
	8	0.95	0.5	20.1	17.4	35.3	16.0	140.0
		1.50	23.9	234.0	171.0	104.0	58.9	196.0
		2.30	161.0	871.0	1,843.0	332.0	400.0	554.0

Note: NA = not analyzed for; BDL = below detection limit.

Table 19

DR Cells Permeant Chemical Analysis Data

	Cell No.	Pore Volume	Bromide ppm	Chloride ppm	TOC ppm	Calcium ppm	Magnesium ppm	Sodium ppm
				Control Cells				
Influent		NA	NA	NA	NA	NA	NA	NA
Effluent	9	5.40	0.7	44.7	10.2	119.0	34.0	165.0
		6.00	BDL	17.9	5.2	56.9	13.3	21.0
		6.65	BDL	9.2	3.7	56.9	13.3	11.1
	10	2.95	1.0	20.3	3.9	48.3	14.6	76.3
		3.50	BDL	19.3	5.5	47.9	14.0	38.4
		4.15	BDL	10.6	4.1	76.9	16.3	22.3
				Well X-1				
Influent			135.0	22,700.0	4.4	992.0	217.0	13,000.0
Effluent	11	2.45	1.3	88.1	14.2	217.0	55.5	275.0
		3.15	121.0	14,700.0	2.2	1,220.0	269.0	7,940.0
		3.80	285.0	28,900.0	3.7	923.0	186.0	14,800.0
	12	2.20	1.0	65.3	12.1	160.0	41.4	215.0
		2.80	109.0	994.0	1.9	1,290.0	304.0	5,100.0
		3.50	250.0	26,400.0	4.2	1,070.0	226.0	13,600.0
				Well X-14				
Influent		0.00	170.0	1,450.0	1,764.0	1,040.0	180.0	47.4
Effluent	13	2.50	1.1	60.1	12.8	143.0	36.5	175.0
		3.10	61.8	281.0	1,098.0	445.0	106.0	82.6
		3.80	129.0	603.0	1,291.5	814.0	195.0	57.8
	14	2.45	1.3	92.4	17.0	232.0	58.5	278.0
		3.10	58.7	179.0	210.0	497.0	125.0	56.3
		3.75	136.0	321.0	1,317.0	822.0	166.0	49.2
				Well X-25				
Influent			28.4	1,200.0	2,970.0	836.0	574.0	656.0
Effluent	15	2.55	1.0	66.1	15.0	143.0	43.7	223.0
		3.05	63.3	809.0	50.3	405.0	255.0	360.0
		3.80	119.0	876.0	951.0	66.2	249.0	698.0
	16	2.85	1.1	81.7	18.0	211.0	54.3	267.0
		3.55	53.6	597.0	180.0	442.0	153.0	235.0
		4.20	146.0	1,040.0	1,050.0	58.9	249.0	706.0

Note: NA = not analyzed for; BDL = below detection limit.

APPENDIX A: LIST OF GROUND WATER ANALYTES AND THEIR RESPECTIVE ANALYTICAL DETECTION LIMITS

Table A1

Organic Analytes and Detection Limits

Analytes	Detection Limit mg/ℓ
Chloromethane	0.010
Bromomethane	0.010
Vinyl chloride	0.010
Chloroethane	0.010
Methylene chloride	0.005
1,1-Dichloroethene	0.005
1,1-Dichloroethane	0.005
Trans-1, 1-dichloroethene	0.005
Cis-1, 2-dichloroethene	0.005
Chloroform	0.005
1,2-dichloroethane	0.005
1,1,1-Trichloroethane	0.005
Carbon tetrachloride	0.005
Bromodichloromethane	0.005
1,2-Dichloropropane	0.005
Trans-1,3-dichloropropane	0.005
Trichloroethene	0.005
Dibromochloromethane	0.005
Cis-1, 3-dichloropropene	0.005
1,1,2-Trichloroethane	0.005
Benzene	0.005
1-Chloroethyl vinyl ether	0.005
Bromoform	0.005
1,1,2,2-Tetrachloroethane	0.005
Tetrachloroethene	0.005
Toluene	0.005
Chlorobenzene	0.005
Ethylbenzene	0.005
Acrolein	0.100

(Continued)

(Sheet 1 of 4)

Table A1 (Continued)

Analytes	Detection Limit mg/ℓ
Acrylonitrite	0.10
Acetone	0.10
2-Butanone	0.10
Carbon disulfide	0.005
2-Hexanone	0.050
4-Methyl-2-pentanone	0.050
Styrene	0.005
Vinyl acetate	0.050
Total xylenes	0.005
Phenol	0.010
2-Chlorophenol	0.010
2-Nitrophenol	0.010
2,4-Dimethylphenol	0.010
2,4-Dichlorophenol	0.010
4-Chloro-3-methylphenol	0.020
2,4,6-Trichlorophenol	0.010
2,4-Dinitrophenol	0.050
4-Nitrophenol	0.050
2-Methyl-4,6-dinitrophenol	0.050
Pentachlorophenol	0.050
Benzoic acid	0.050
2-Methylphenol	0.010
4-Methylphenol	0.010
2,4,5-Trichlorophenol	0.010
Benzyl alcohol	0.020
N-Nitrosodimethylamine	0.010
Bis(2-chloroisopropyl)ether	0.010
N-Nitroso-di-n-propylamine	0.010
Nitrobenzene	0.010

(Continued)

(Sheet 2 of 4)

Table A1 (Continued)

Analytes	Detection Limit mg/ℓ
Isophorone	0.010
Bis(2-chloroethoxy)methane	0.010
2,6-Dinitrotoluene	0.010
2,4-Dinitrotoluene	0.010
1,2-Diphenylhydrazine	0.010
Benzidine	0.050
3,3-Dichlorobenzidine	0.020
Bis(2-chloroethyl)ether	0.010
1,3-Dichlorobenzene	0.010
1,4-Dichlorobenzene	0.010
1,2-Dichlorobenzene	0.010
Hexachloroethane	0.010
1,2,4-Trichlorobenzene	0.010
Naphthalene	0.010
Hexachlorobutadiene	0.010
Hexachloracyclopentadiene	0.010
2-Chloronaphthalene	0.010
Acenaphthylene	0.010
Dimethyl phthalate	0.010
Acenaphthene	0.010
Fluorene	0.010
Dithyl phthalate	0.010
4-Chlorophenyl phenyl ether	0.010
N-Nitrosodiphenyl amine	0.010
4-Bromophenyl ether	0.010
Hexachlorobenzene	0.010
Phenanthrene	0.010
Anthracene	0.010
Dihoxylphthalate	0.010
Fluoranthene	0.010

(Continued)

(Sheet 3 of 4)

Table A1 (Concluded)

Analytes	Detection Limit mg/ℓ
Pyrene	0.010
Butylbenzylphthalate	0.010
Chrysene	0.010
Benzo(a)anthracene	0.010
Bis(2-ethylhexyl) phthalate	0.010
Di-n-octylphthalate	0.010
Benzo(b)fluoranthene	0.010
Benzo(k)fluoranthene	0.010
Benzo(a)pyrene	0.010
Indeno(1,2,3-c,d)pyrene	0.010
Dibenzo(A,H)anthracene	0.010
Benzo(G,H,I)perylene	0.010
Aniline	0.010
4-Chloroaniline	0.020
Dibenzofuran	0.010
2-Methylnaphthalene	0.010
2-Nitroaniline	0.050
3-Nitroaniline	0.050
4-Nitroaniline	0.050
Total organic carbon	1.000

(Sheet 4 of 4)

Table A2

Inorganic Analytes and Detection Limits

Analytes	Detection Limit mg/ℓ
Ammonia	0.10
Bromide	0.10
Chloride	0.010
Fluoride	0.010
Kjeldahl nitrogen	0.10
Nitrate	0.10
Phosphate	0.10
Sulfide	0.10
Sulfate	0.10
Biochemical oxygen demand	0.10
Chemical oxygen demand	0.10
Conductivity	1.0
Hardness	1.0
Alkalinity	0.10
Oil and grease	0.10
Antimony	0.005
Arsenic	0.001
Beryllium	0.005
Cadmium	0.0001
Chromium	0.001
Copper	0.001
Lead	0.001
Mercury	0.0004
Nickel	0.001
Selenium	0.005
Silver	0.001
Thallium	0.001
Zinc	0.005
Aluminum	0.005

(Continued)

(Sheet 1 of 2)

Table A2 (Concluded)

Analytes	Detection Limit mg/ℓ
Barium	0.005
Boron	0.005
Calcium	0.005
Chromium VI	0.001
Cobalt	0.050
Iron	0.030
Magnesium	0.100
Manganese	0.030
Molybdenum	0.050
Potassium	0.100
Sodium	0.100
Silica	0.200
Vanadium	0.030

(Sheet 2 of 2)

APPENDIX B: GEOTECHNICAL ANALYSIS OF BORROW MATERIALS

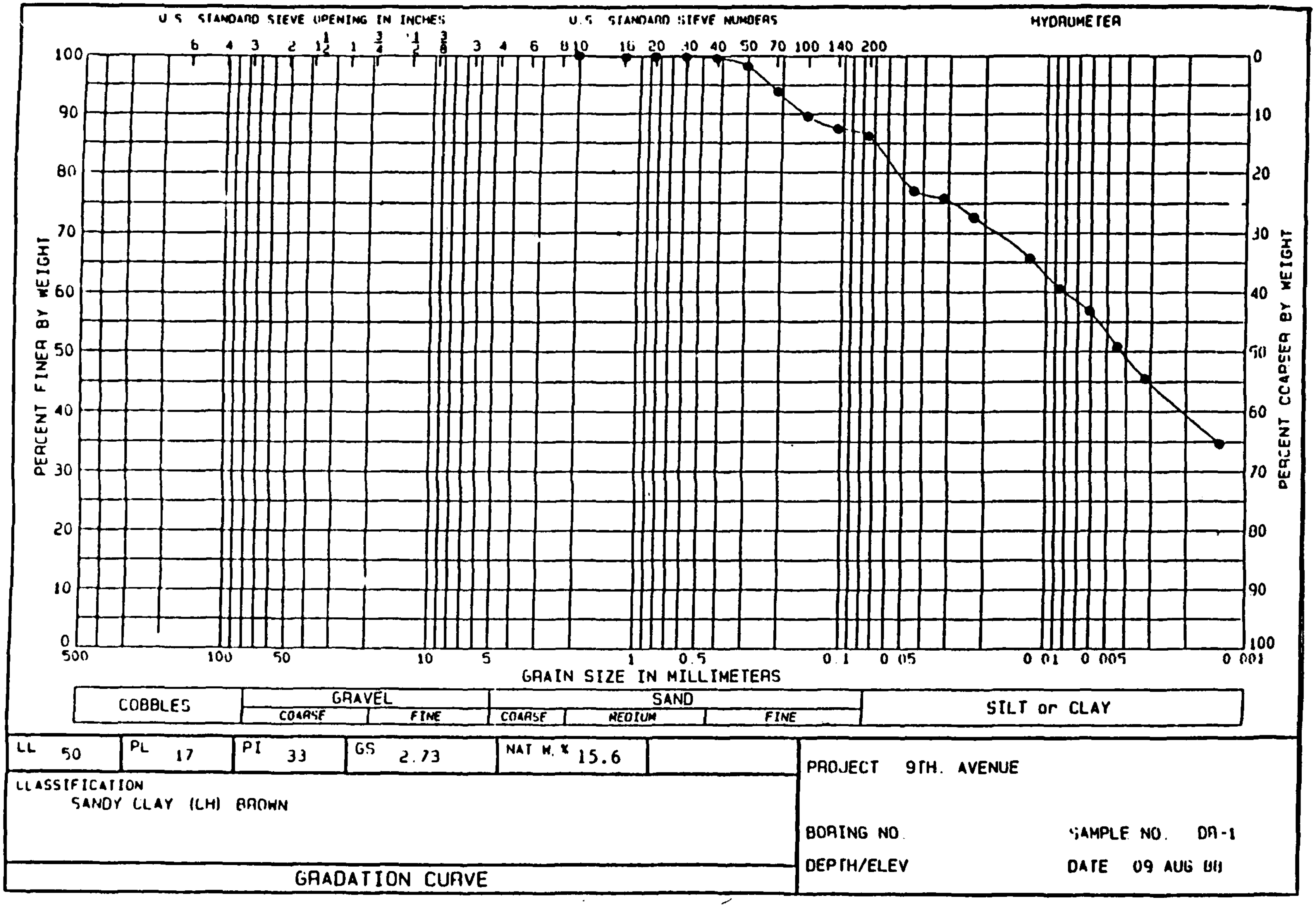


Figure B1. Sample DR-11

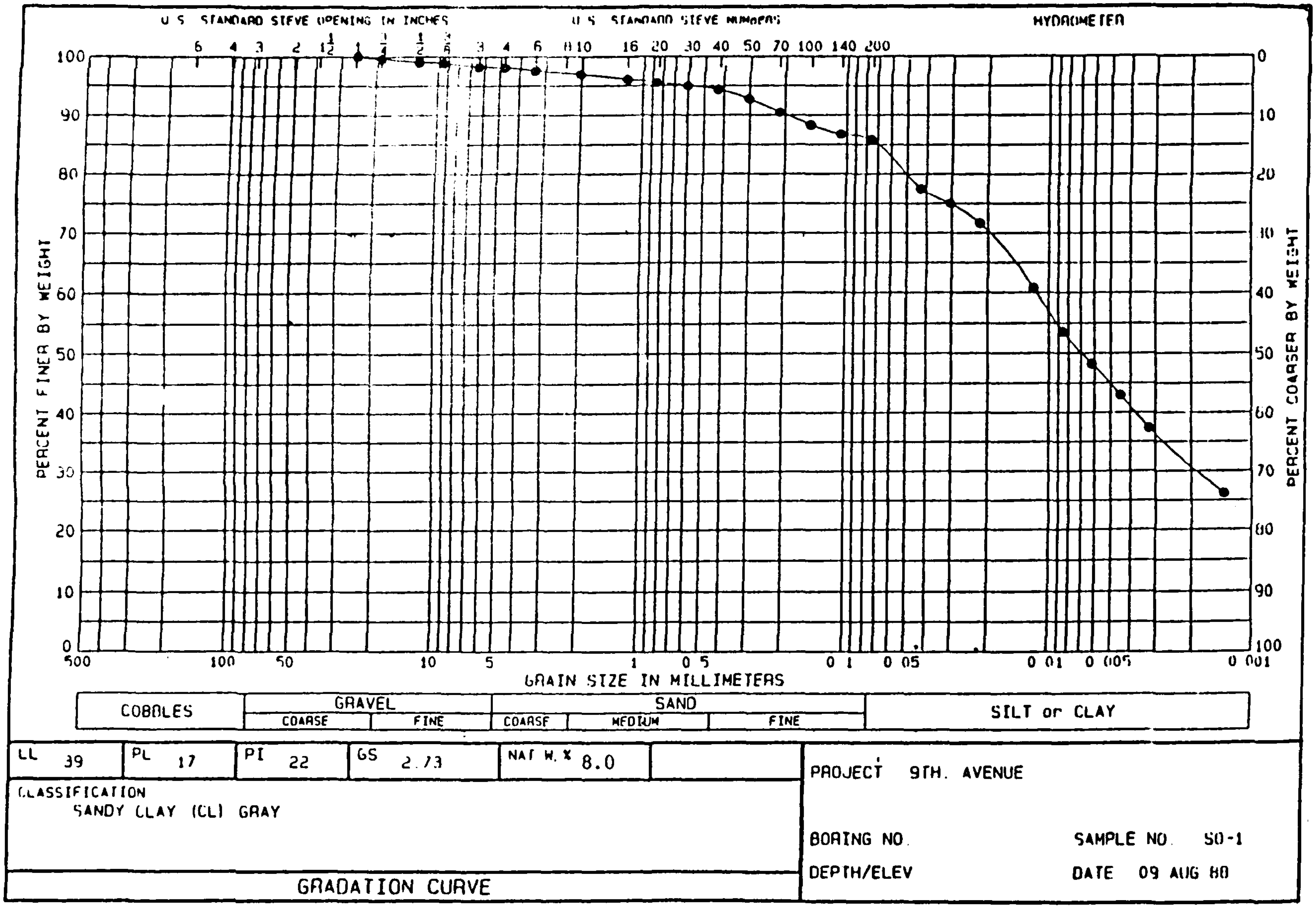


Figure B2. Sample SO-12

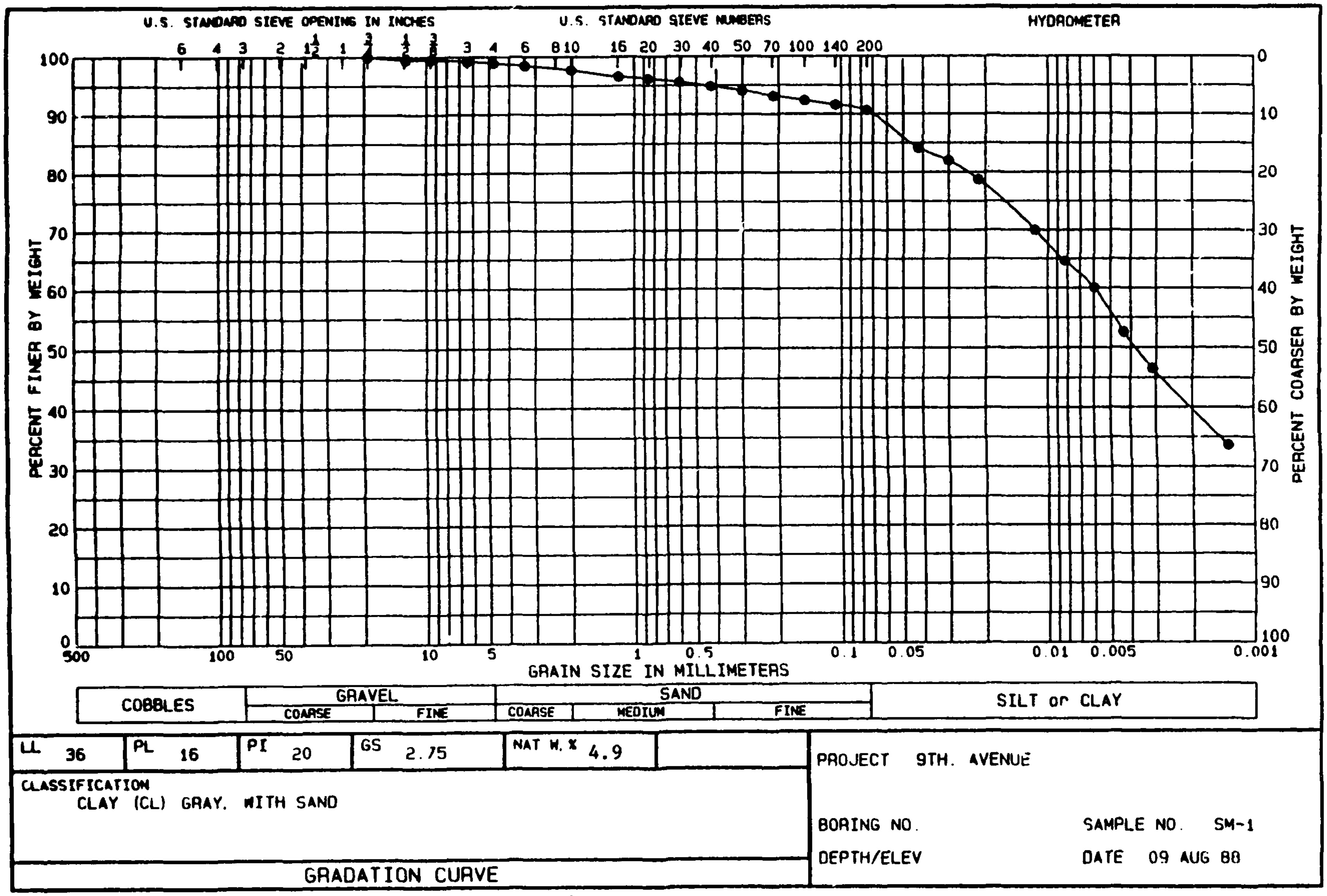
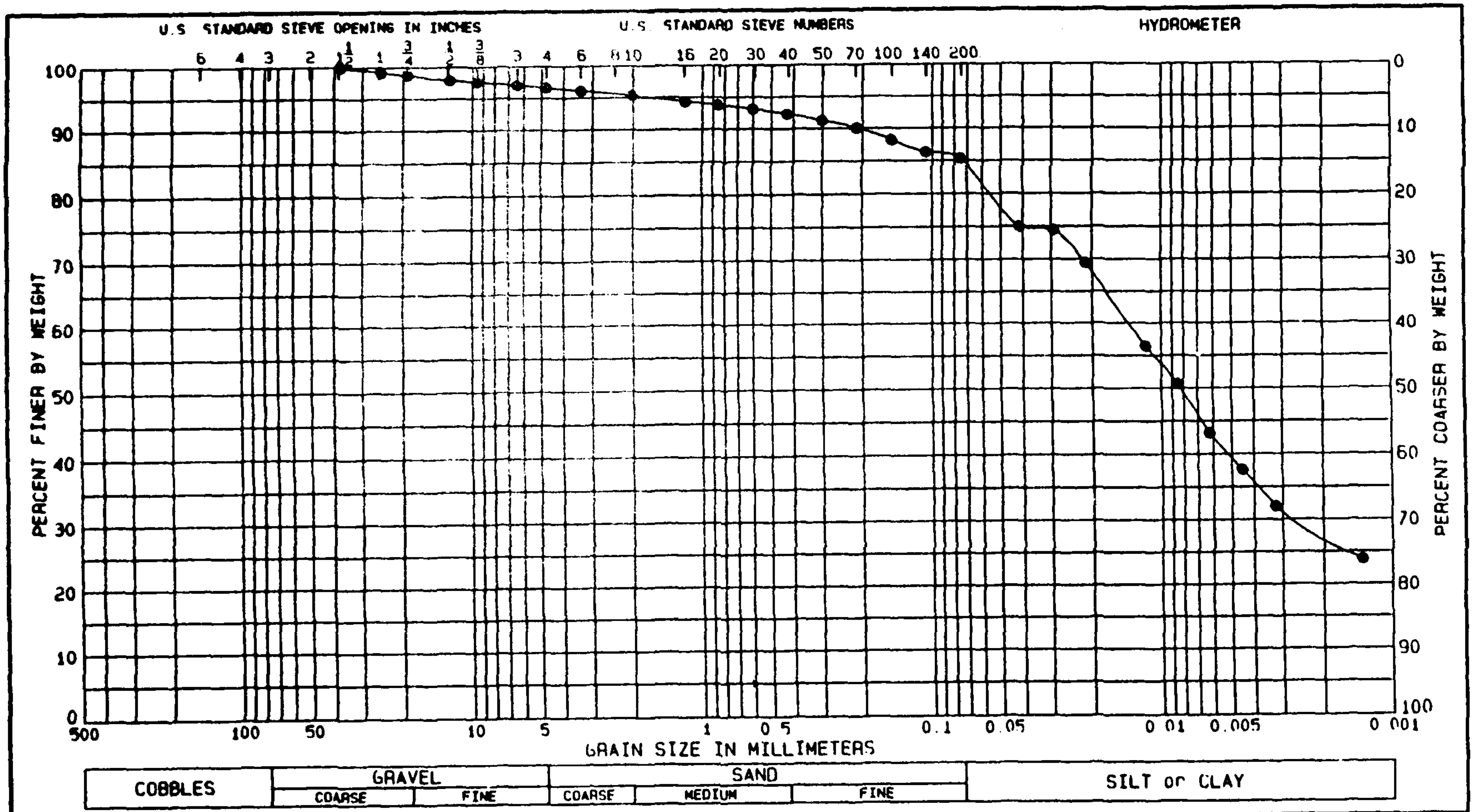


Figure B3. Sample SM-1



LL 28	PL 16	PI 12	GS 2.76	NAT W. % 19.4	

CLASSIFICATION
CLAY (CL) BROWN, WITH SAND, TRACE OF GRAVEL

GRADATION CURVE

PROJECT 9TH. AVENUE

BORING NO.

SAMPLE NO. OL-1

DEPTH/ELEV

DATE 09 AUG 88

Figure B4. Sample OL-1

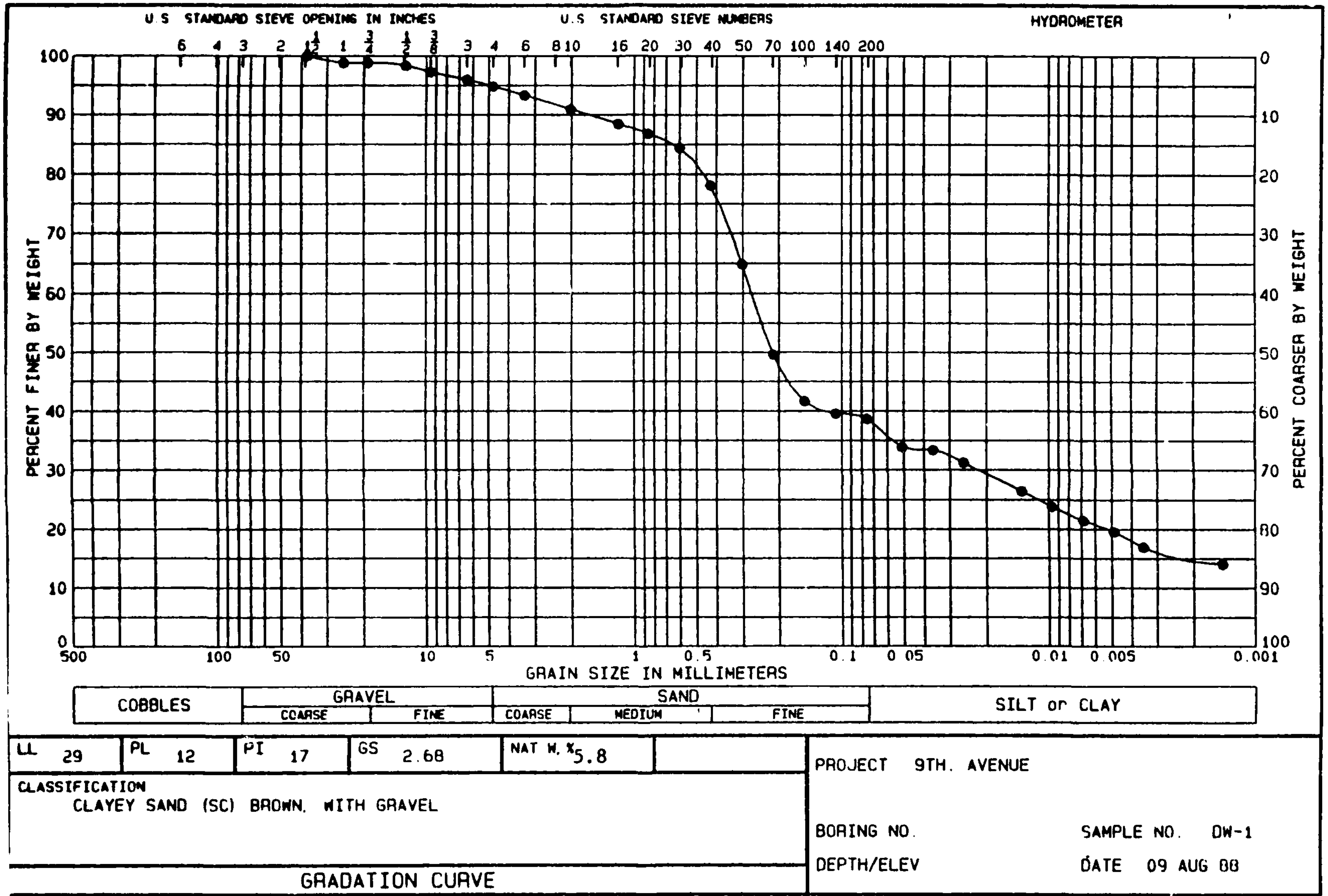
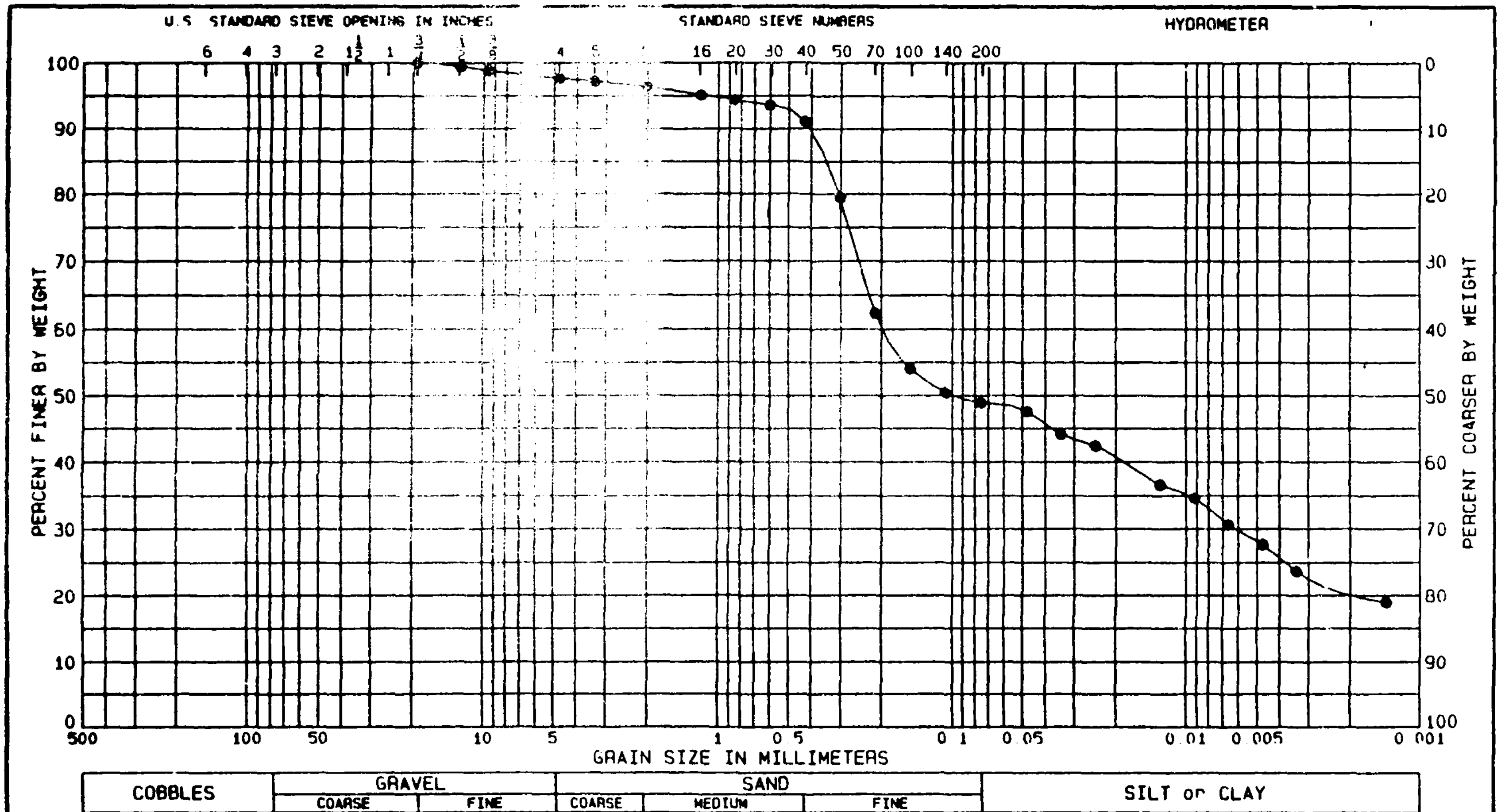


Figure B5. Sample DW-1



LL 30	PL 13	PI 17	GS 2.68	NAT W, % 12.2		PROJECT 9TH. AVENUE
CLASSIFICATION CLAYEY SAND (SC) BROWN						BORING NO. / SAMPLE NO. IMT
GRADATION CURVE						DEPTH/ELEV / DATE 09 AUG 88

Figure B6. Sample IMT

APPENDIX C: HYDRAULIC GRADIENT VERSUS HYDRAULIC CONDUCTIVITY DATA

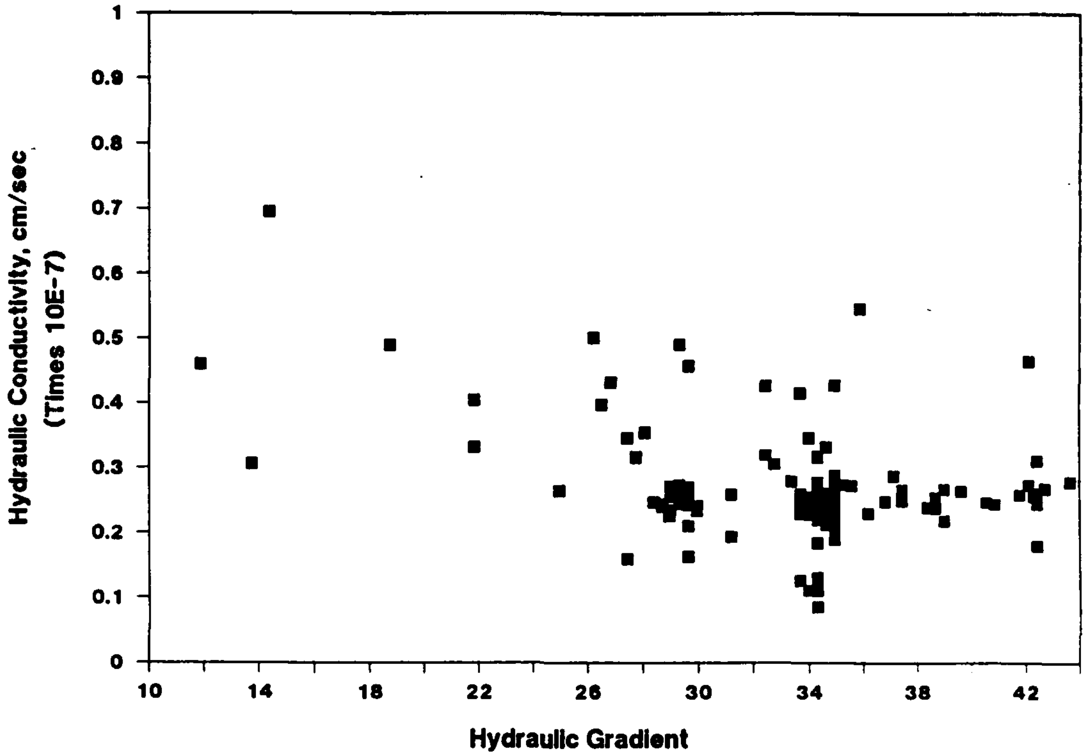


Figure C1. Cell 1 hydraulic gradient versus hydraulic conductivity data

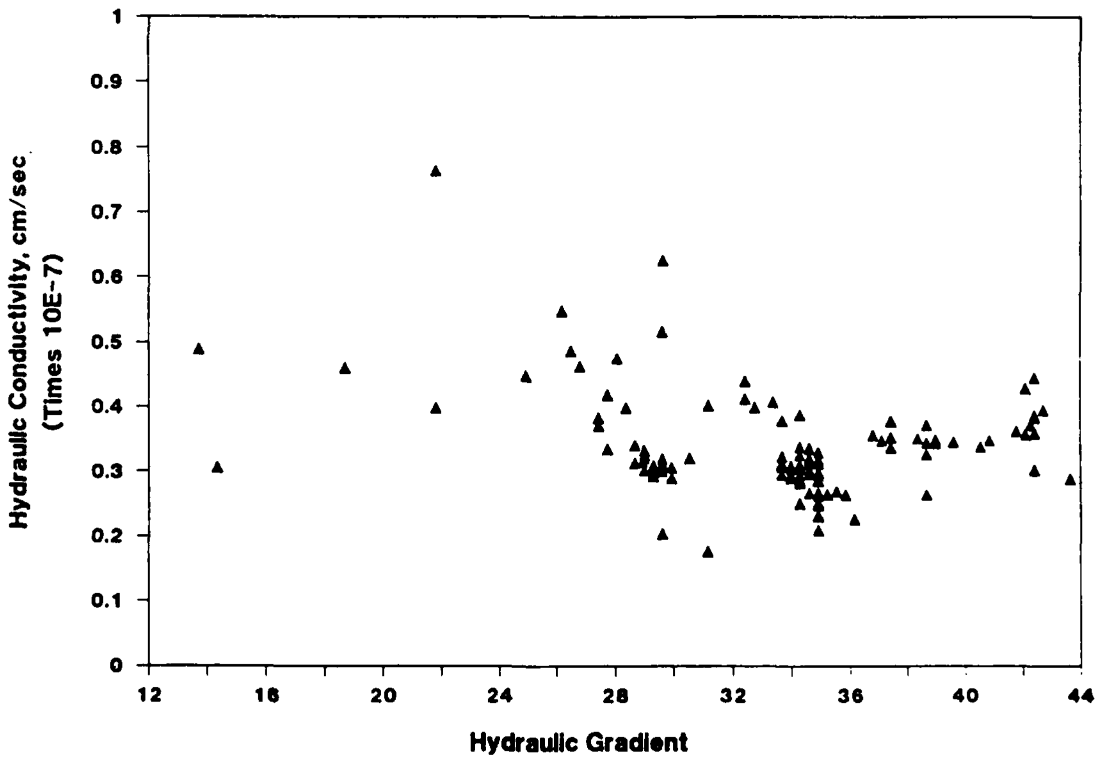


Figure C2. Cell 2 hydraulic gradient versus hydraulic conductivity data

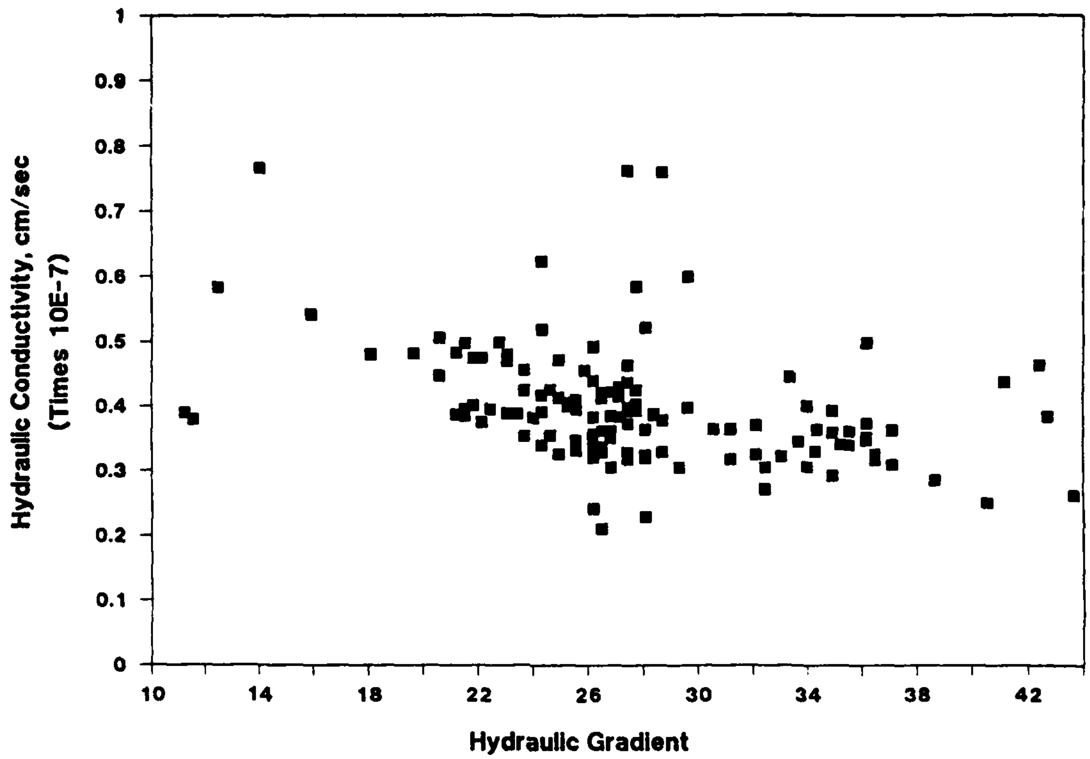


Figure C3. Cell 3 hydraulic gradient versus hydraulic conductivity data

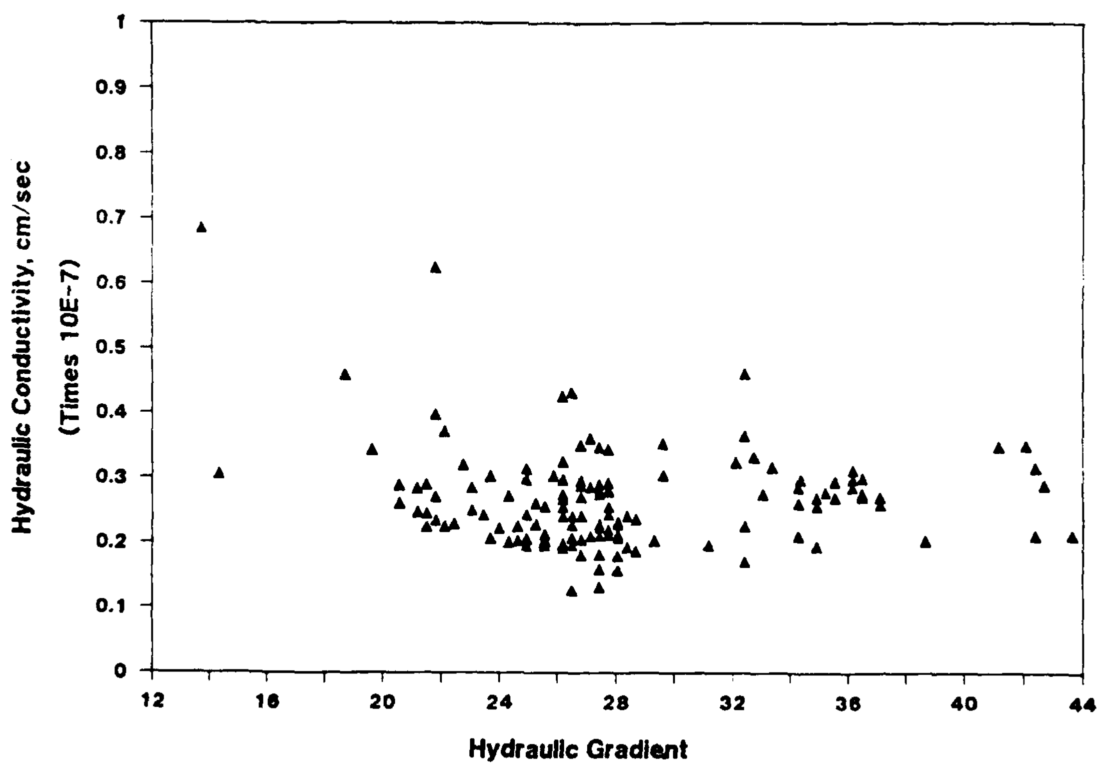


Figure C4. Cell 4 hydraulic gradient versus hydraulic conductivity data

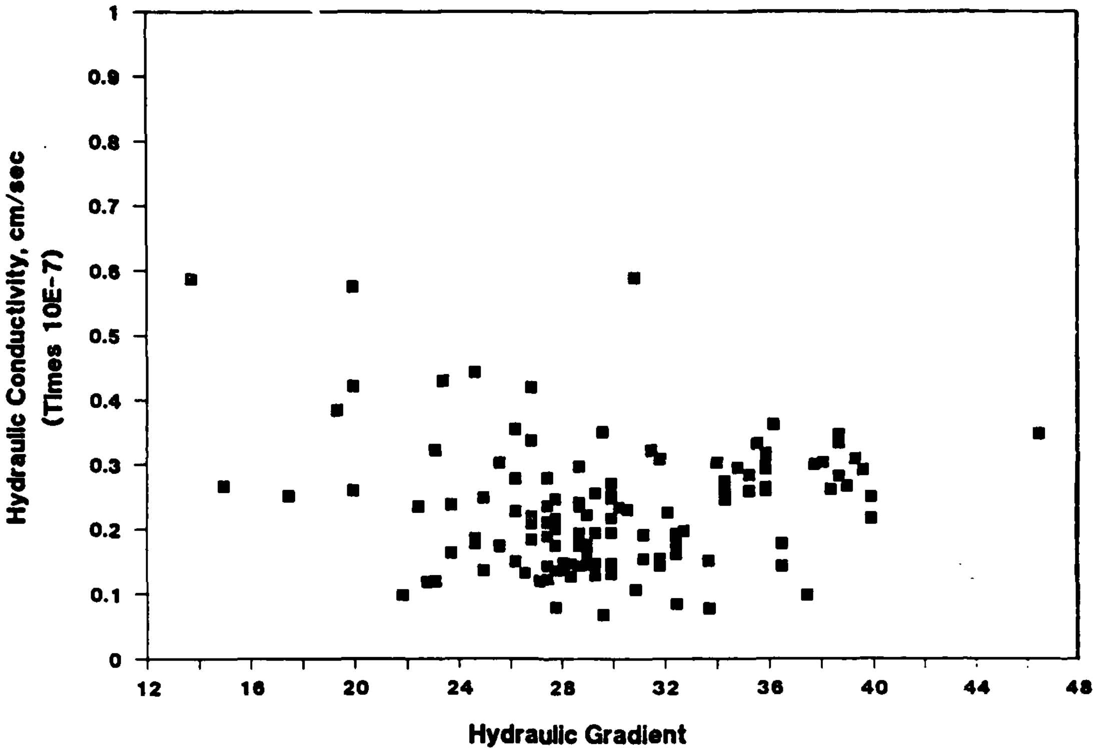


Figure C5. Cell 5 hydraulic gradient versus hydraulic conductivity data

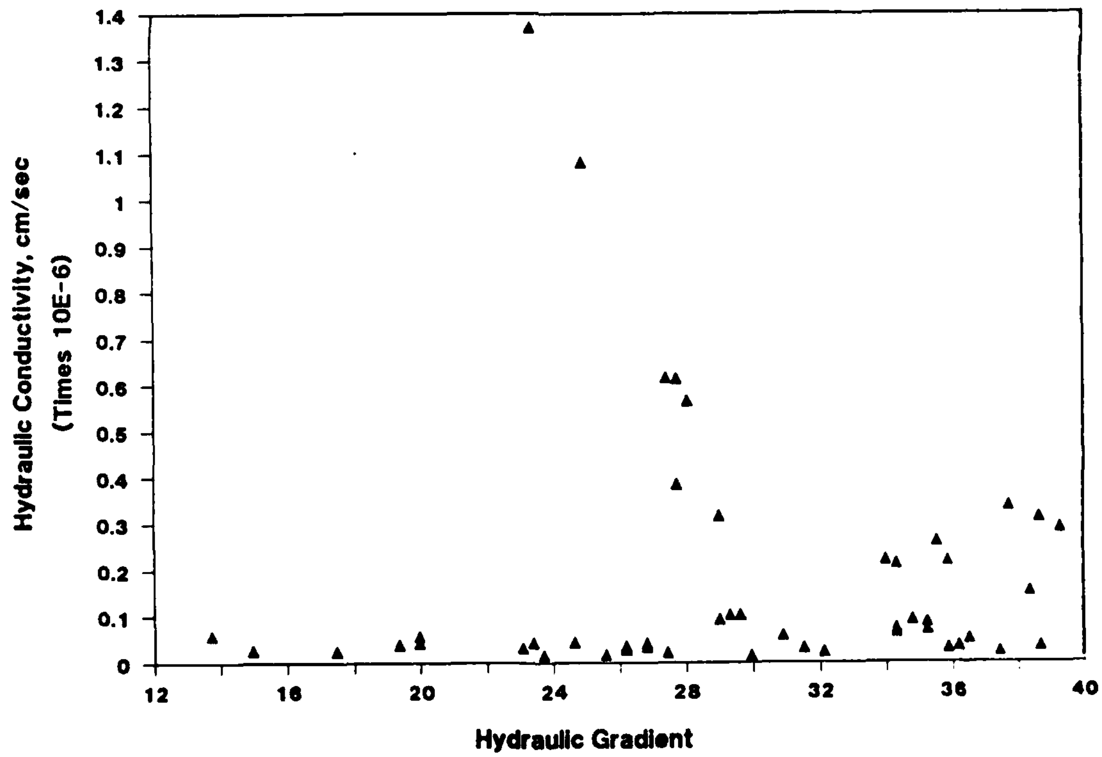


Figure C6. Cell 6 hydraulic gradient versus hydraulic conductivity data

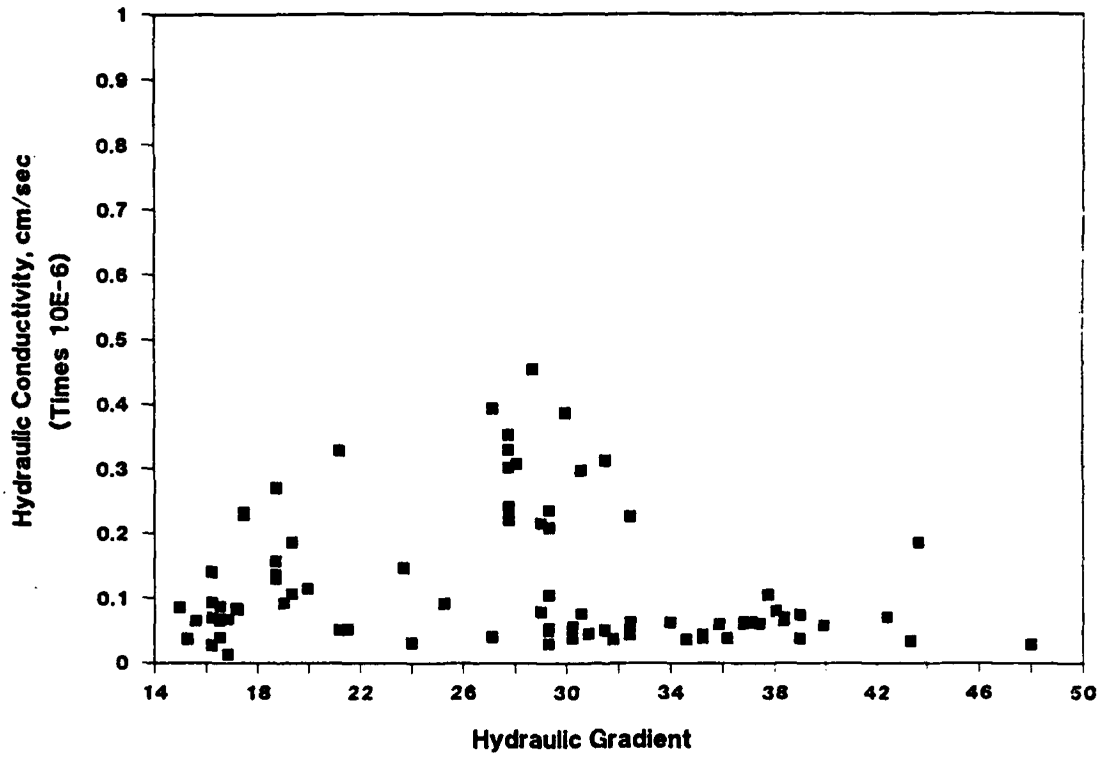


Figure C7. Cell 7 hydraulic gradient versus hydraulic conductivity data

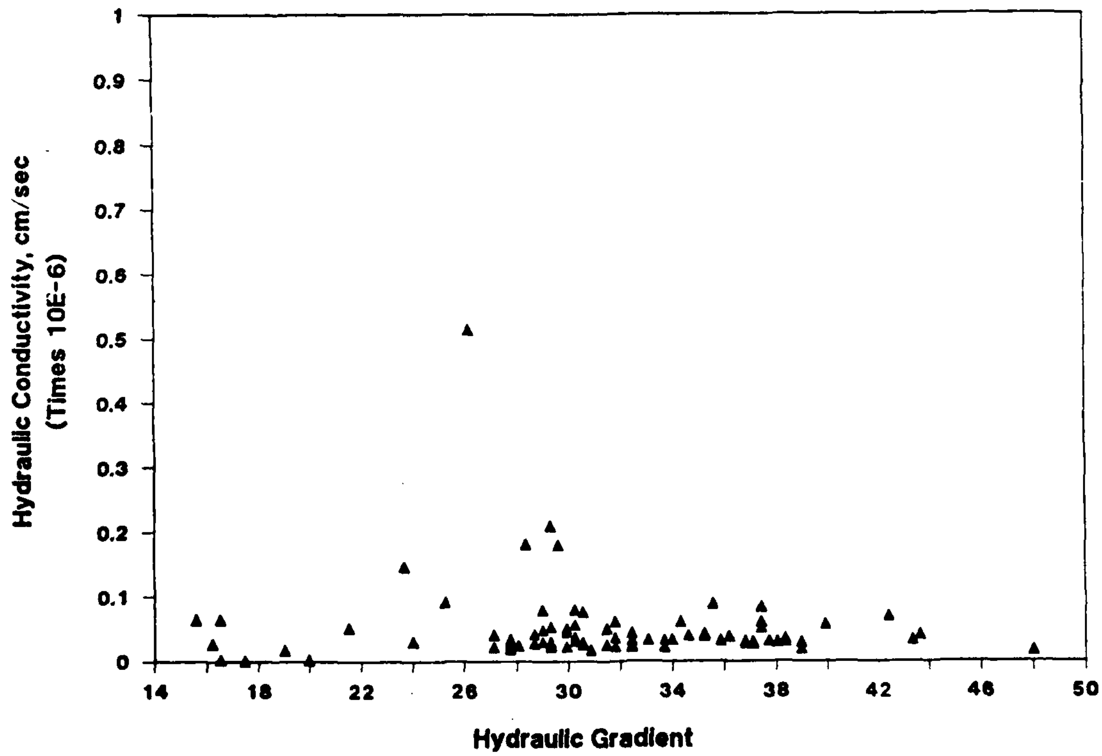


Figure C8. Cell 8 hydraulic gradient versus hydraulic conductivity data

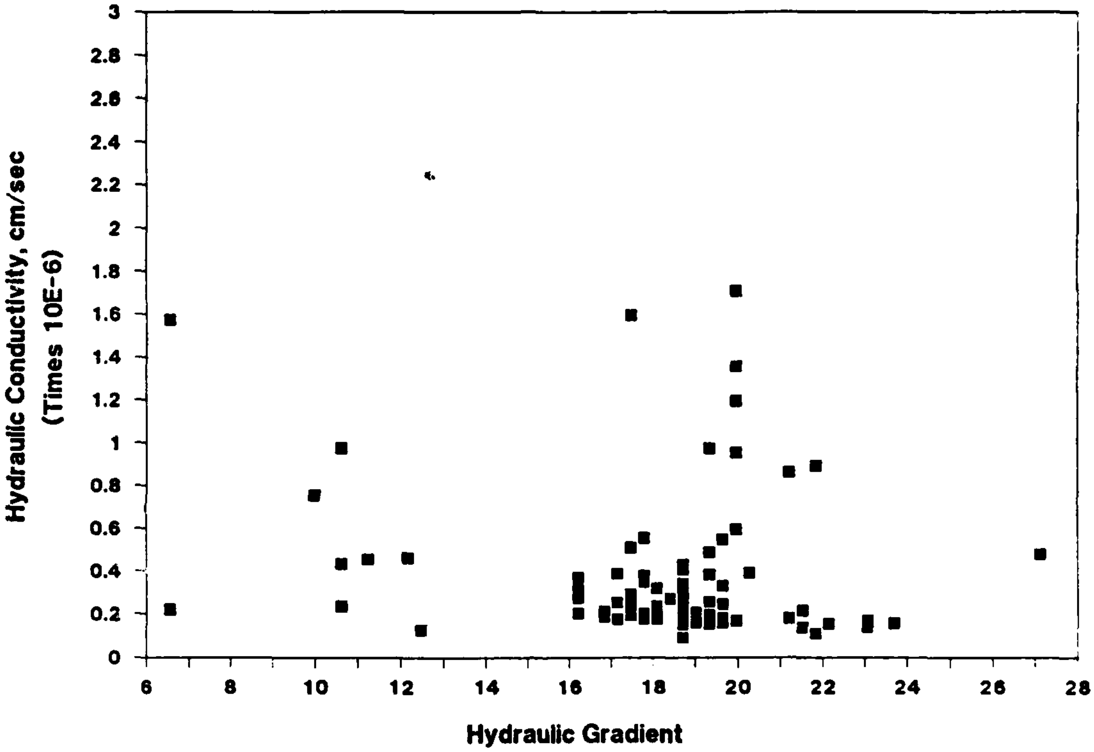


Figure C9. Cell 9 hydraulic gradient versus hydraulic conductivity data

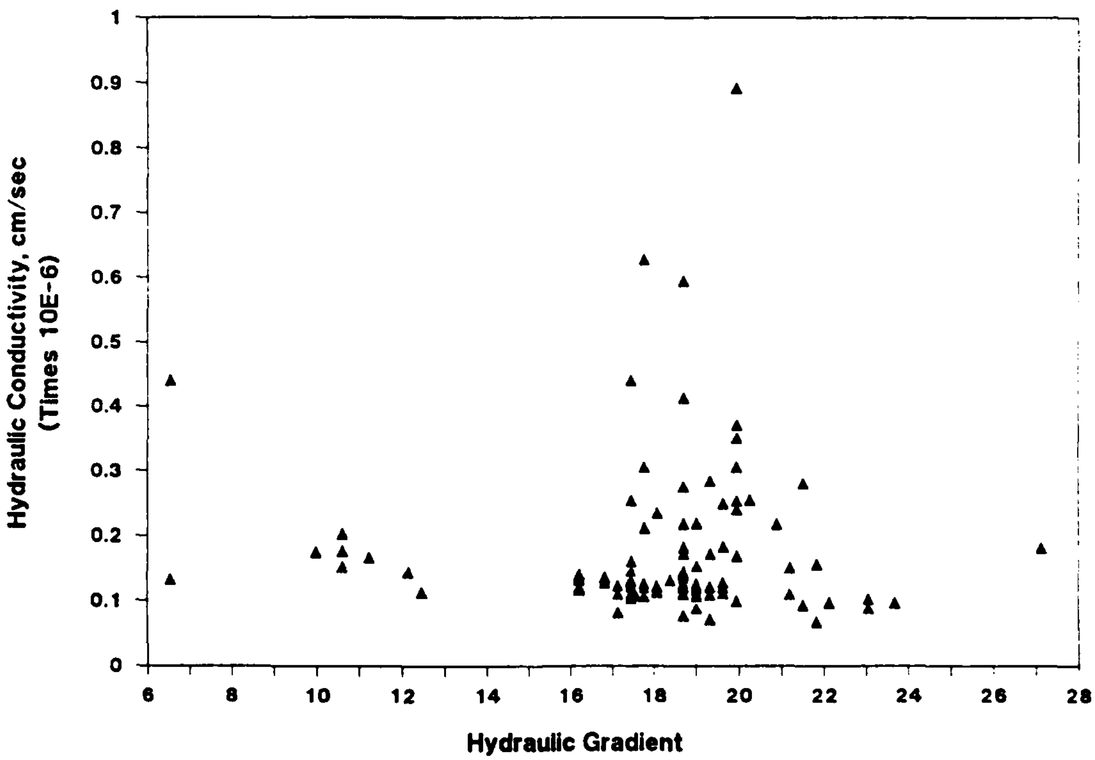


Figure C10. Cell 10 hydraulic gradient versus hydraulic conductivity data

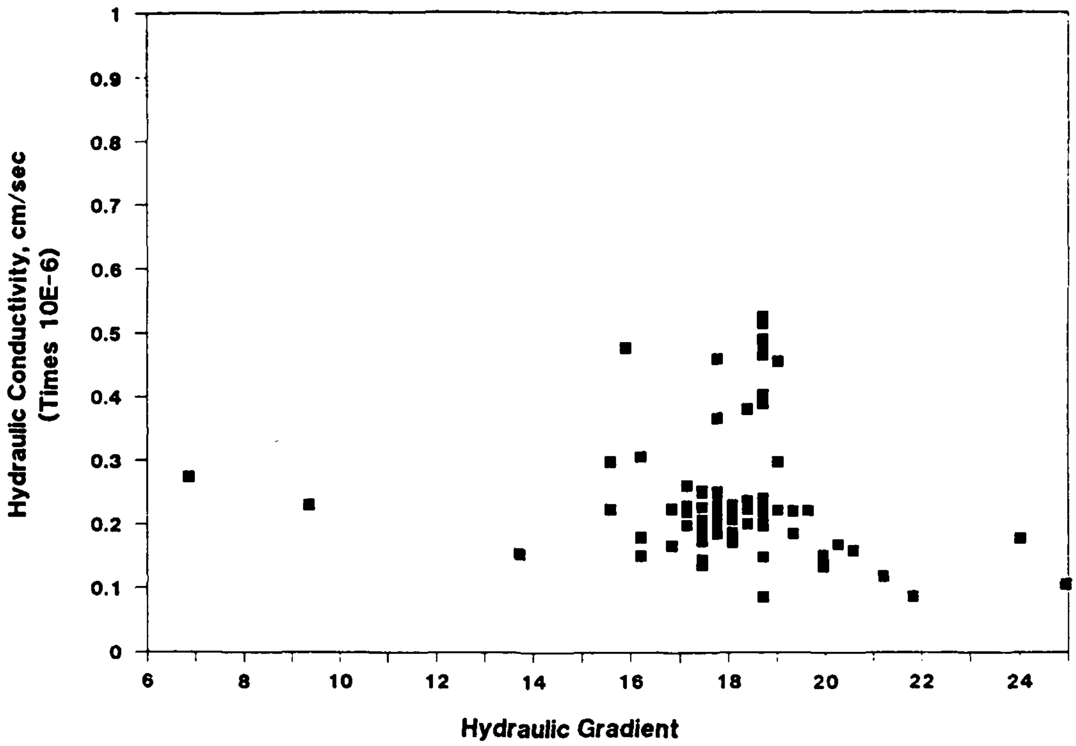


Figure C11. Cell 11 hydraulic gradient versus hydraulic conductivity data

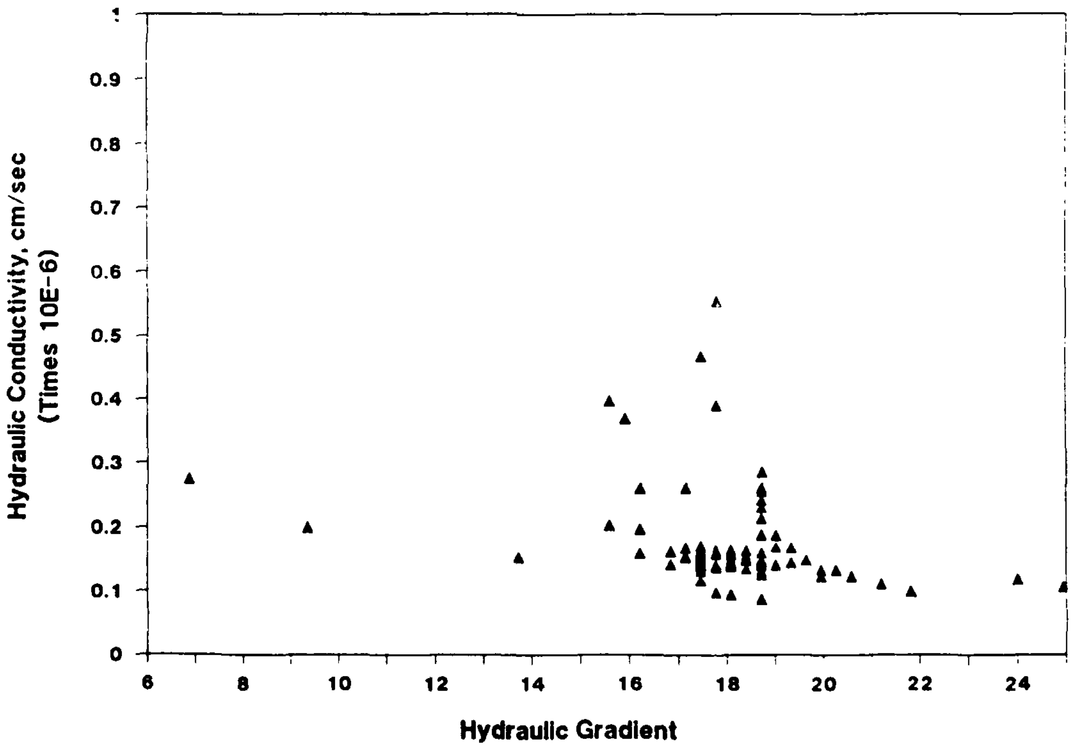


Figure C12. Cell 12 hydraulic gradient versus hydraulic conductivity data

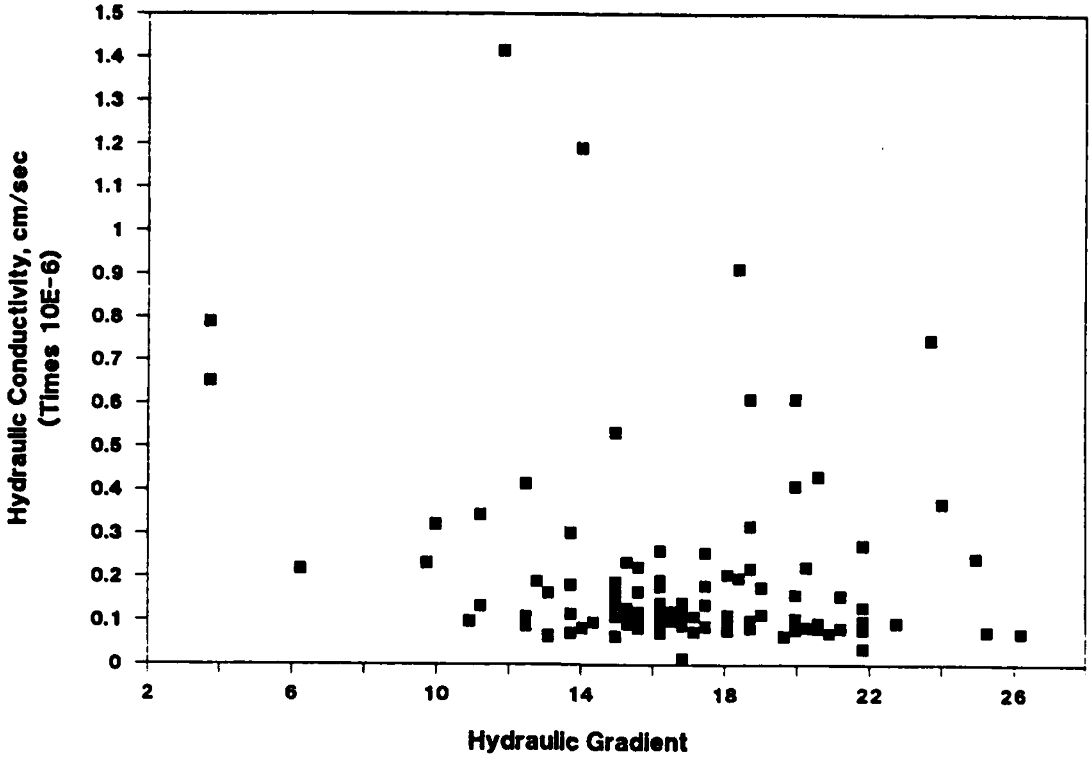


Figure C13. Cell 13 hydraulic gradient versus hydraulic conductivity data

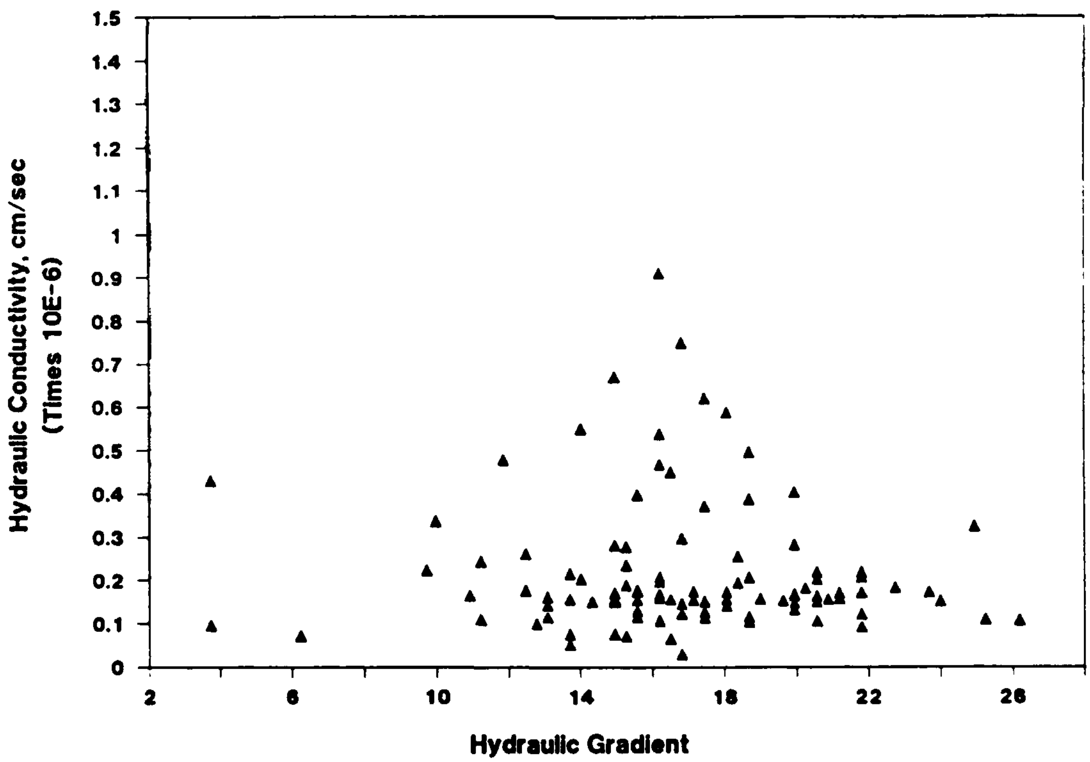


Figure C14. Cell 14 hydraulic gradient versus hydraulic conductivity data

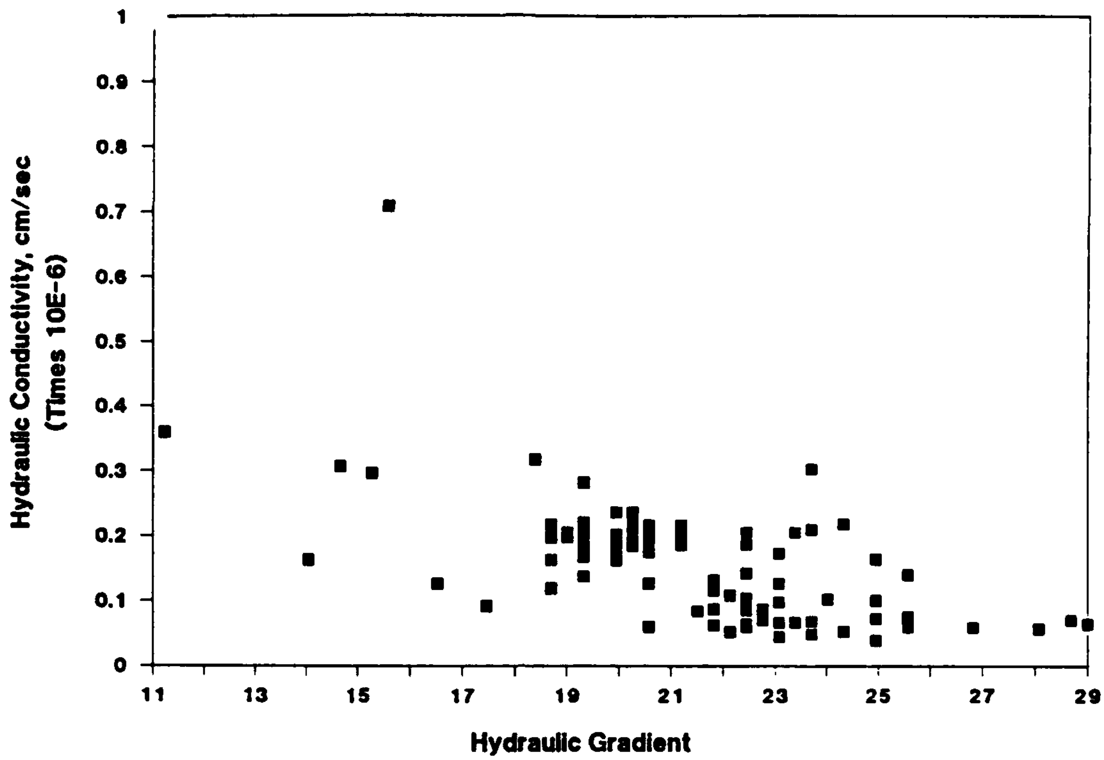


Figure C15. Cell 15 hydraulic gradient versus hydraulic conductivity data

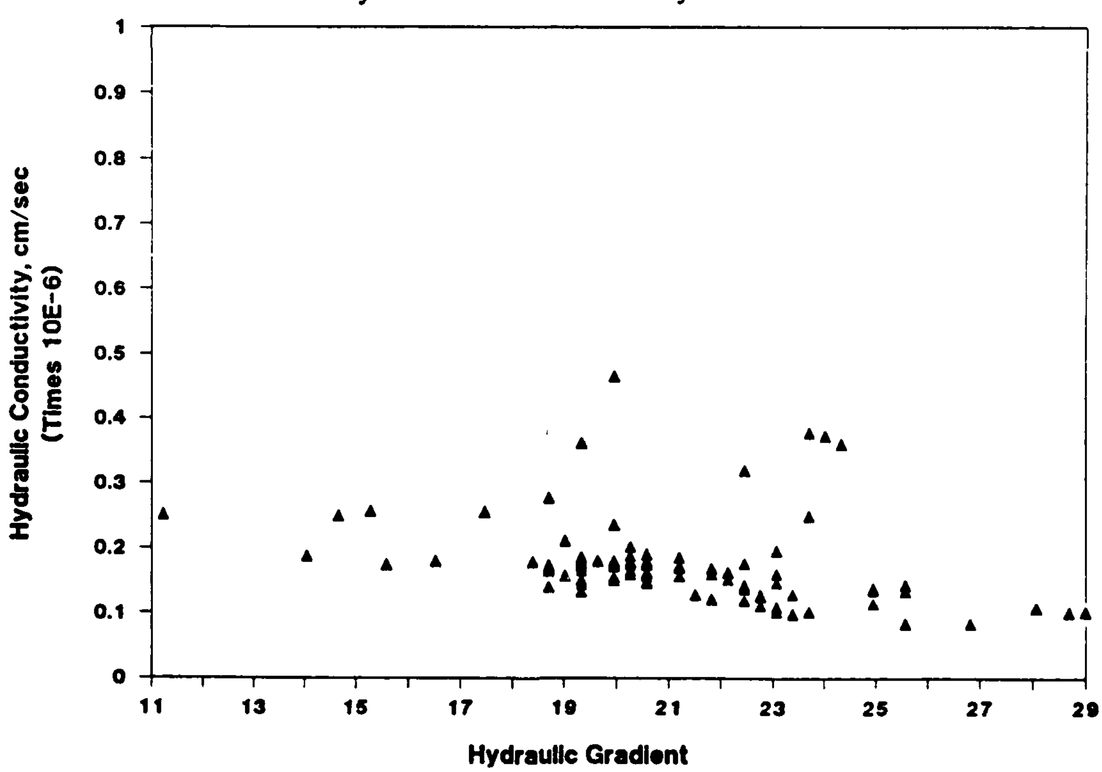


Figure C16. Cell 16 hydraulic gradient versus hydraulic conductivity data

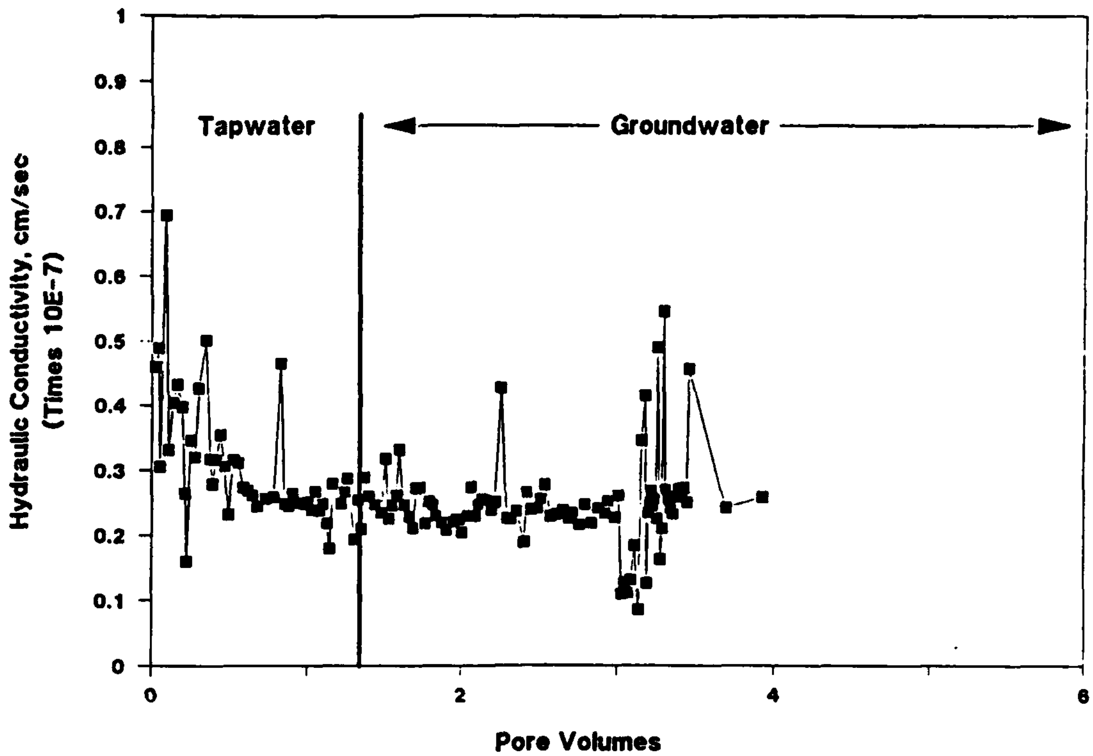


Figure C17. Cell 1 hydraulic conductivity data

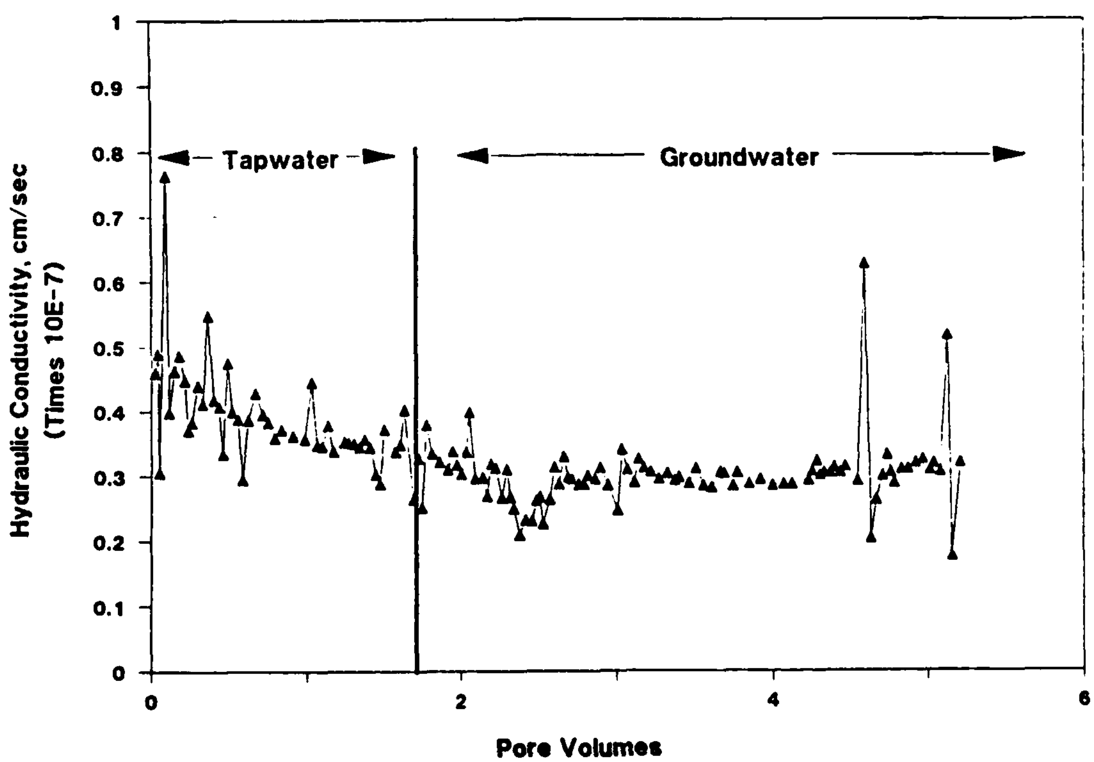


Figure C18. Cell 2 hydraulic conductivity data

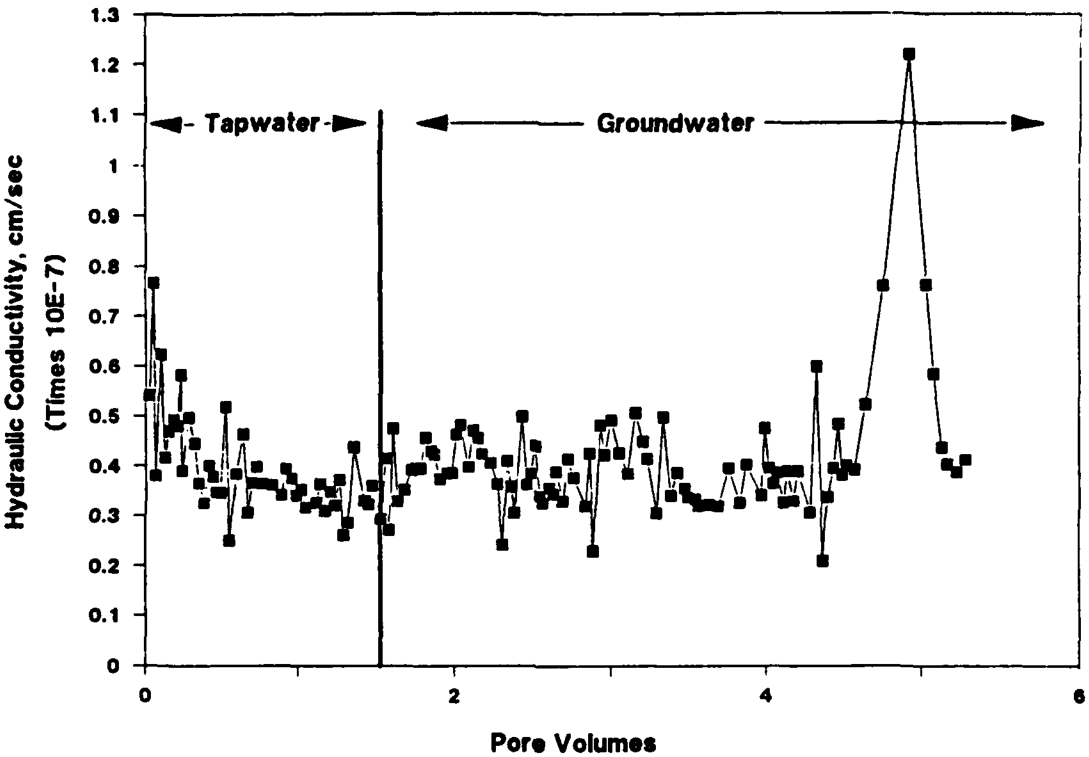


Figure C19. Cell 3 hydraulic conductivity data

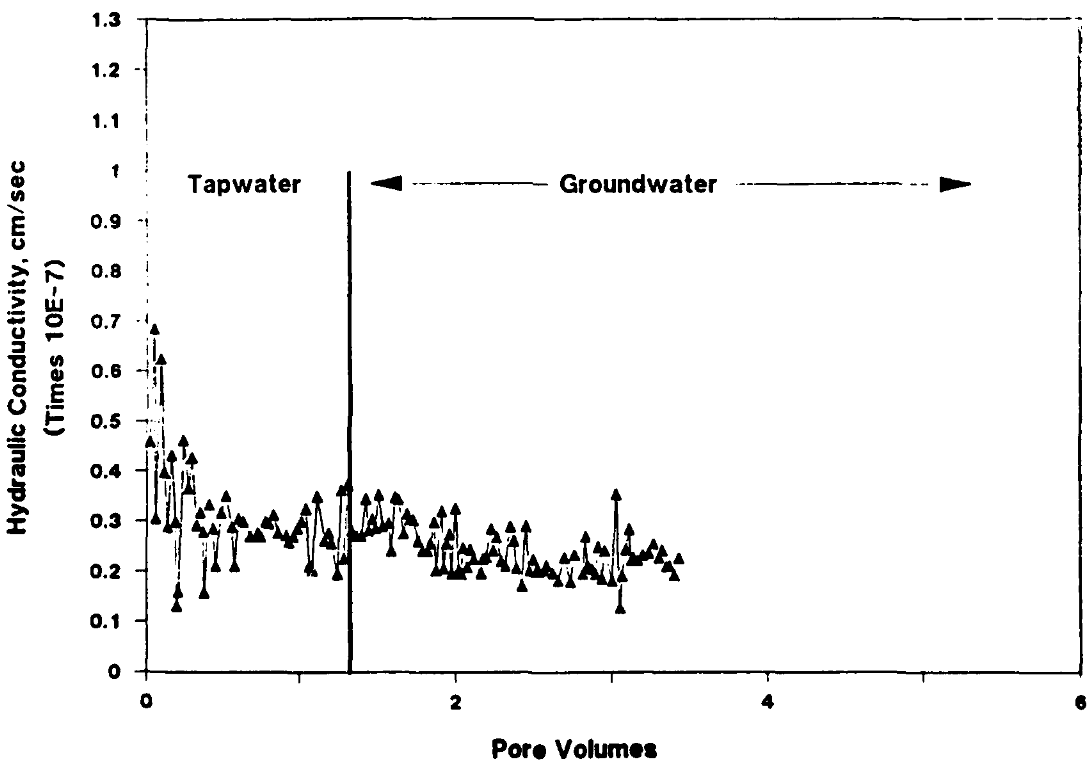


Figure C20. Cell 4 hydraulic conductivity data

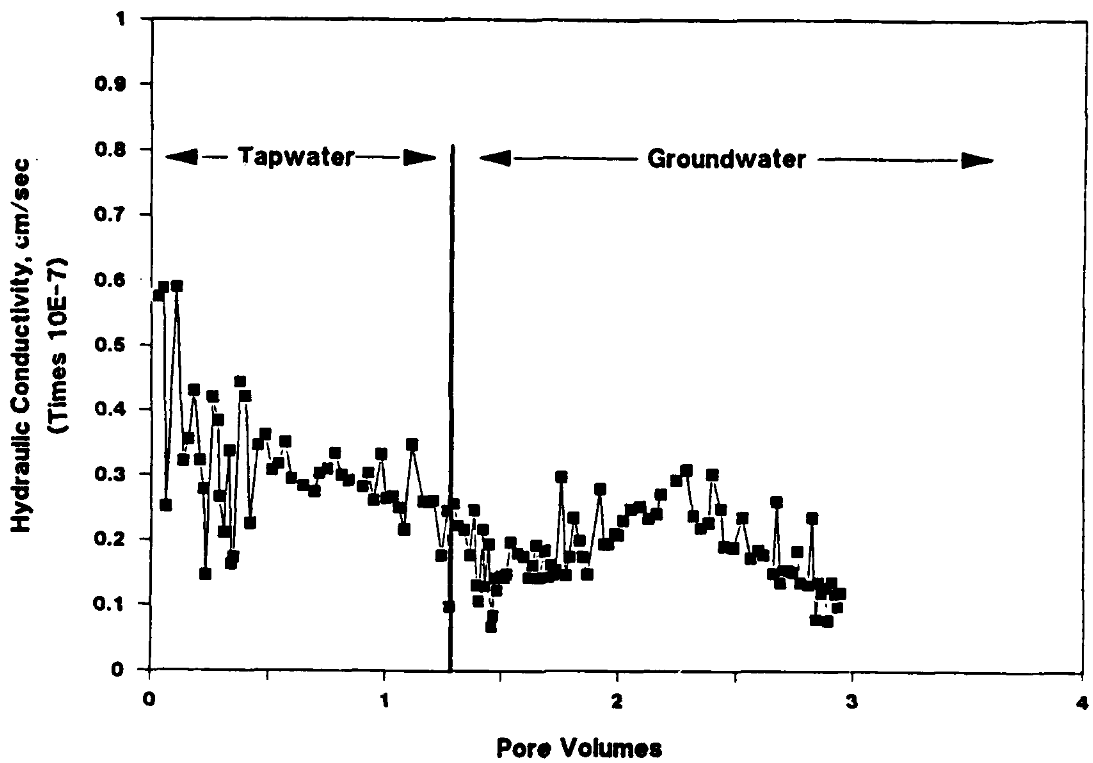


Figure C21. Cell 5 hydraulic conductivity data

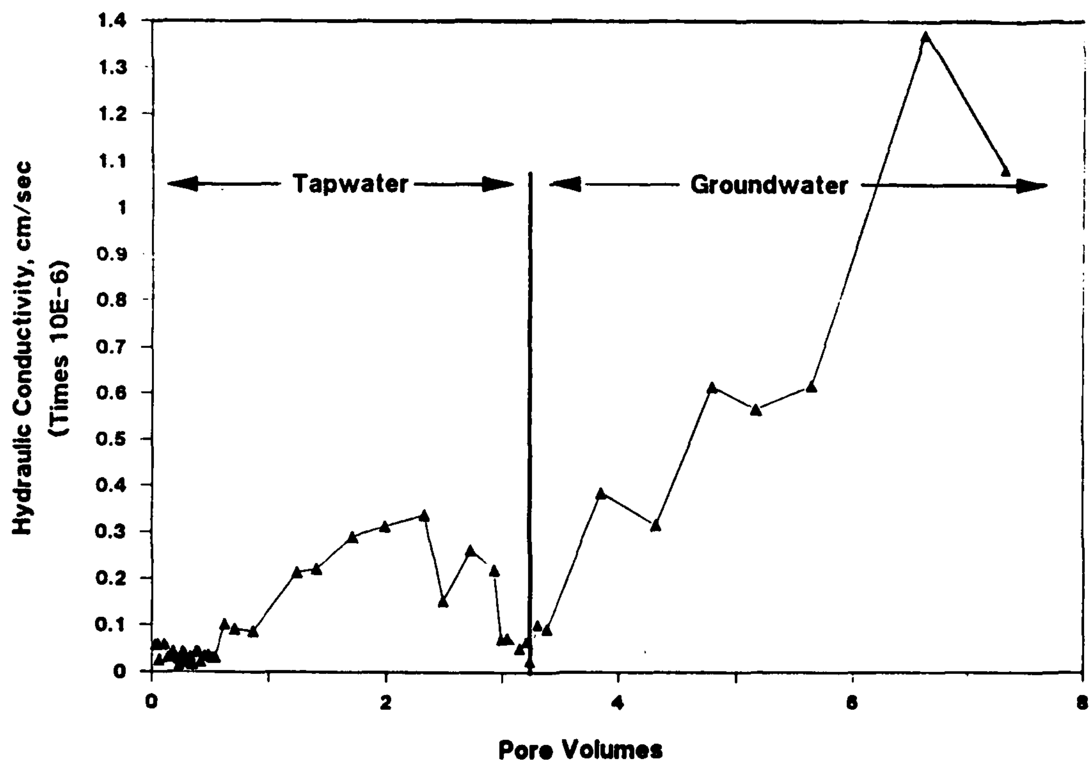


Figure C22. Cell 6 hydraulic conductivity data

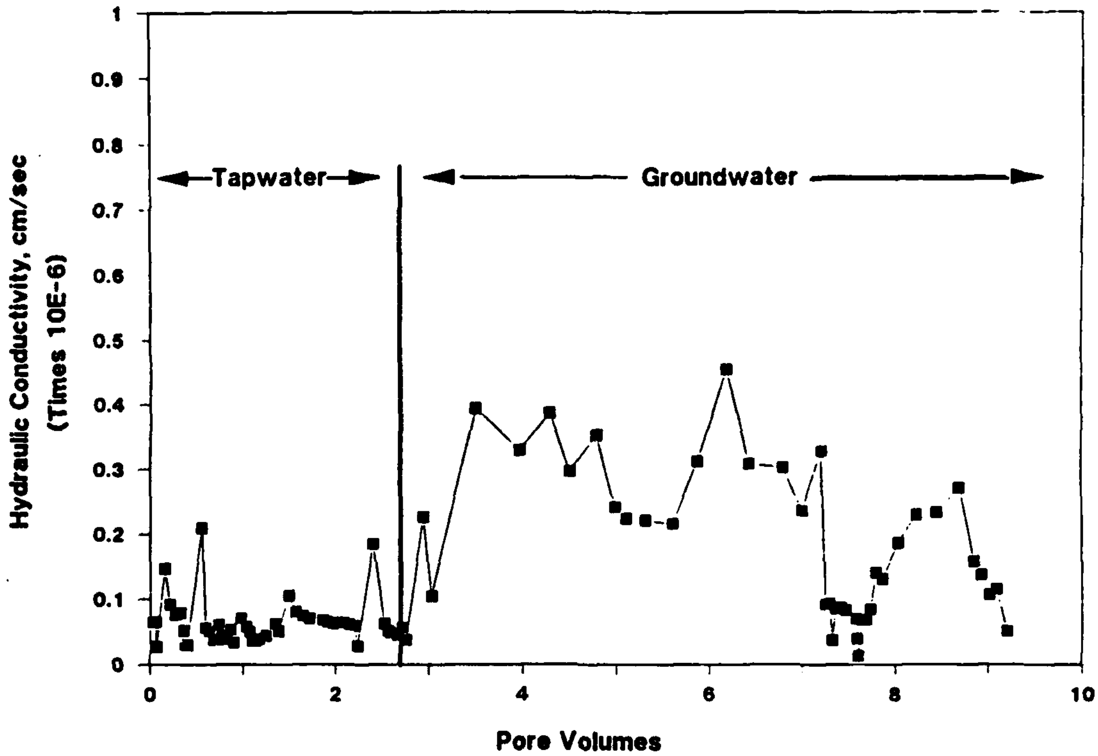


Figure C23. Cell 7 hydraulic conductivity data

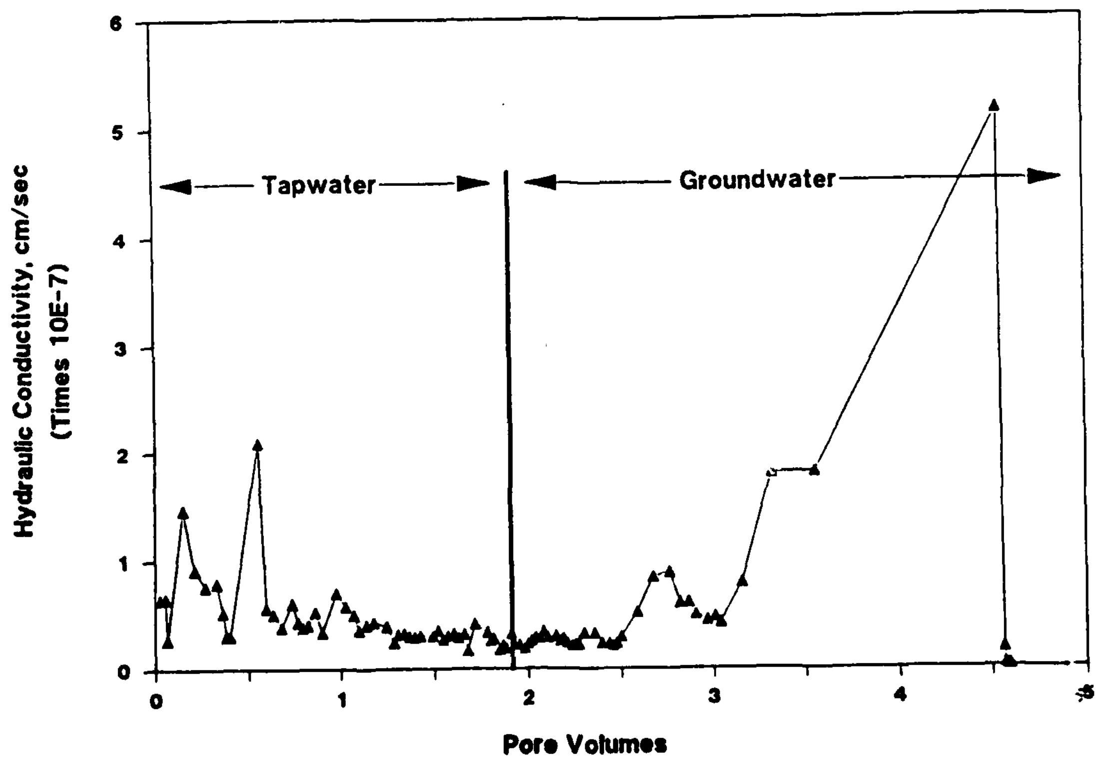


Figure C24. Cell 8 hydraulic conductivity data

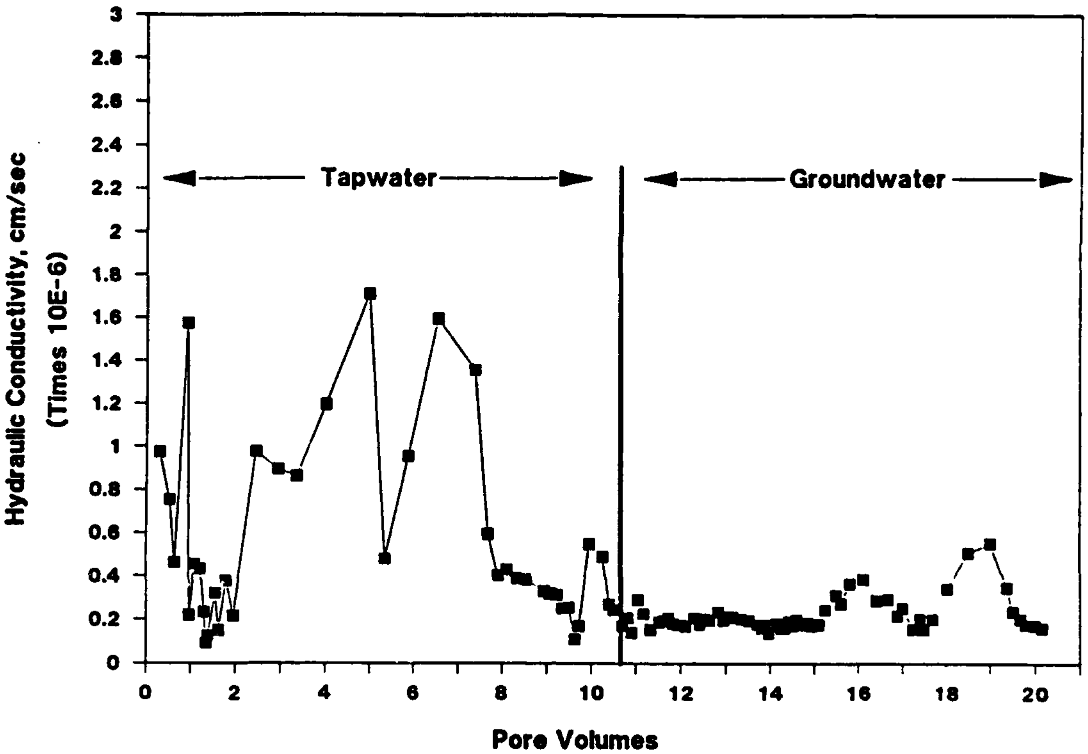


Figure C25. Cell 9 hydraulic conductivity data

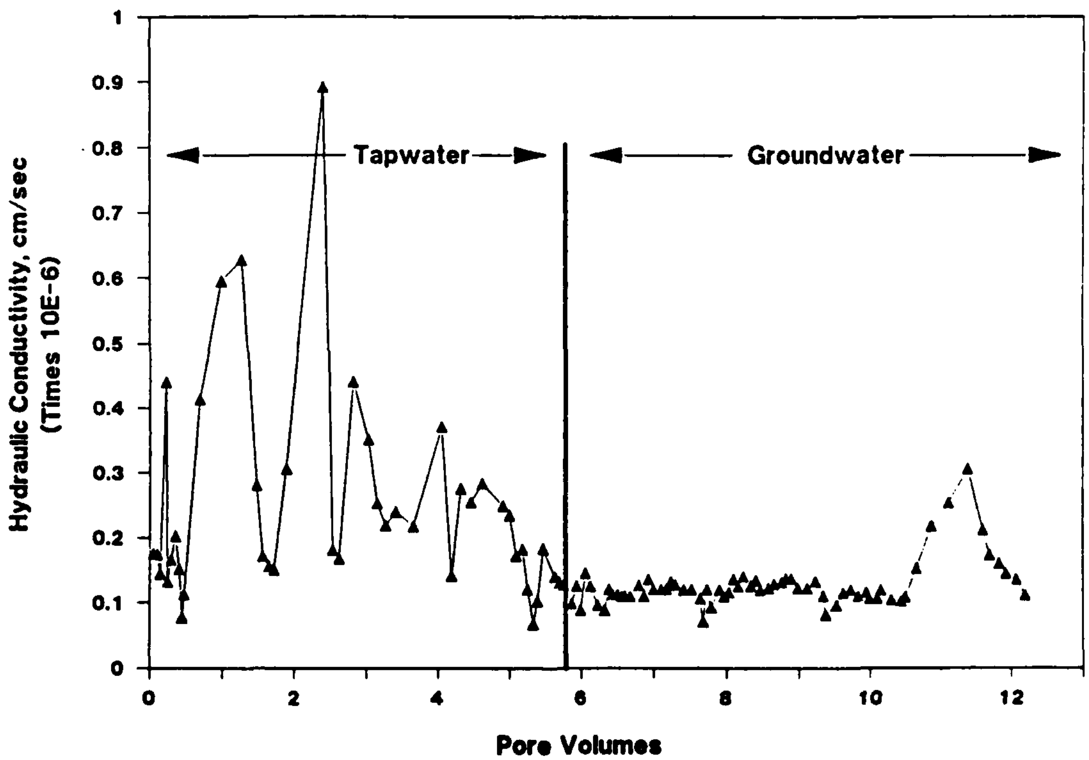


Figure C26. Cell 10 hydraulic conductivity data

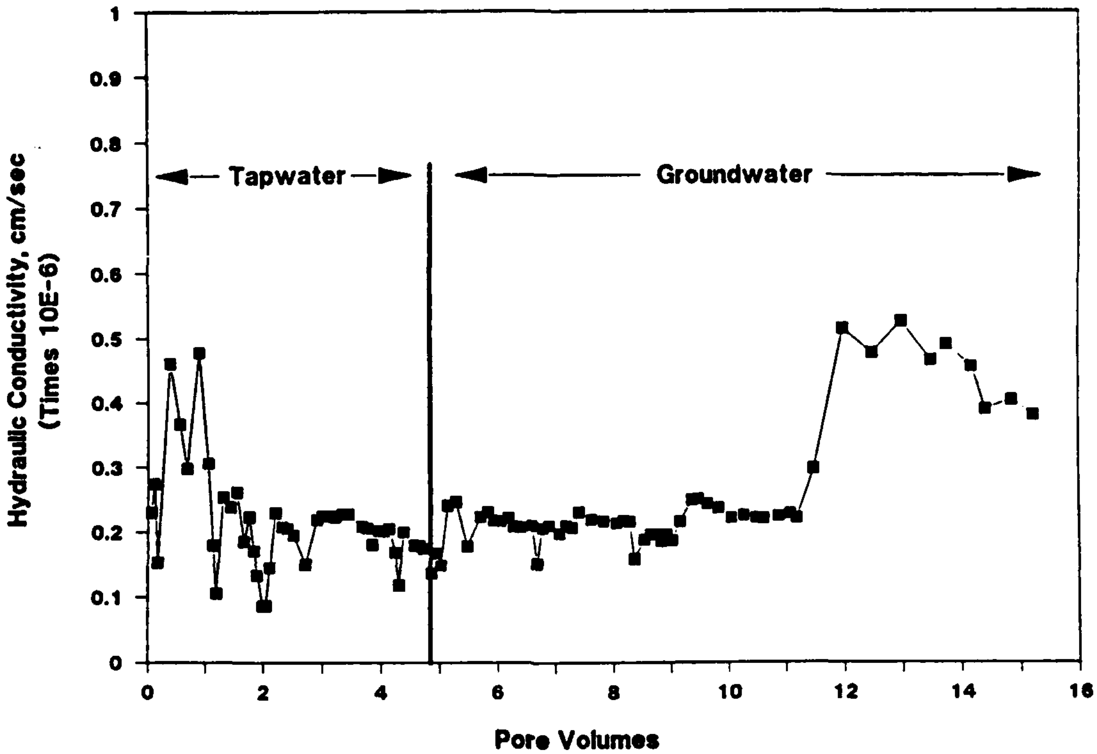


Figure C27. Cell 11 hydraulic conductivity data

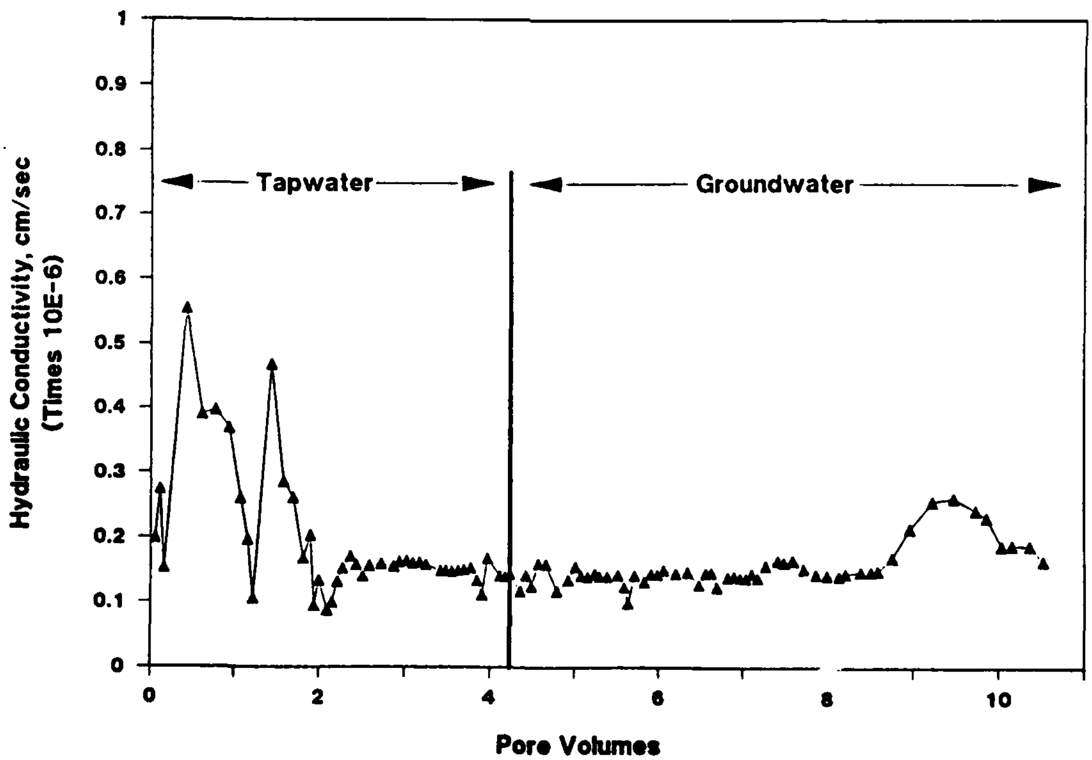


Figure C28. Cell 12 hydraulic conductivity data

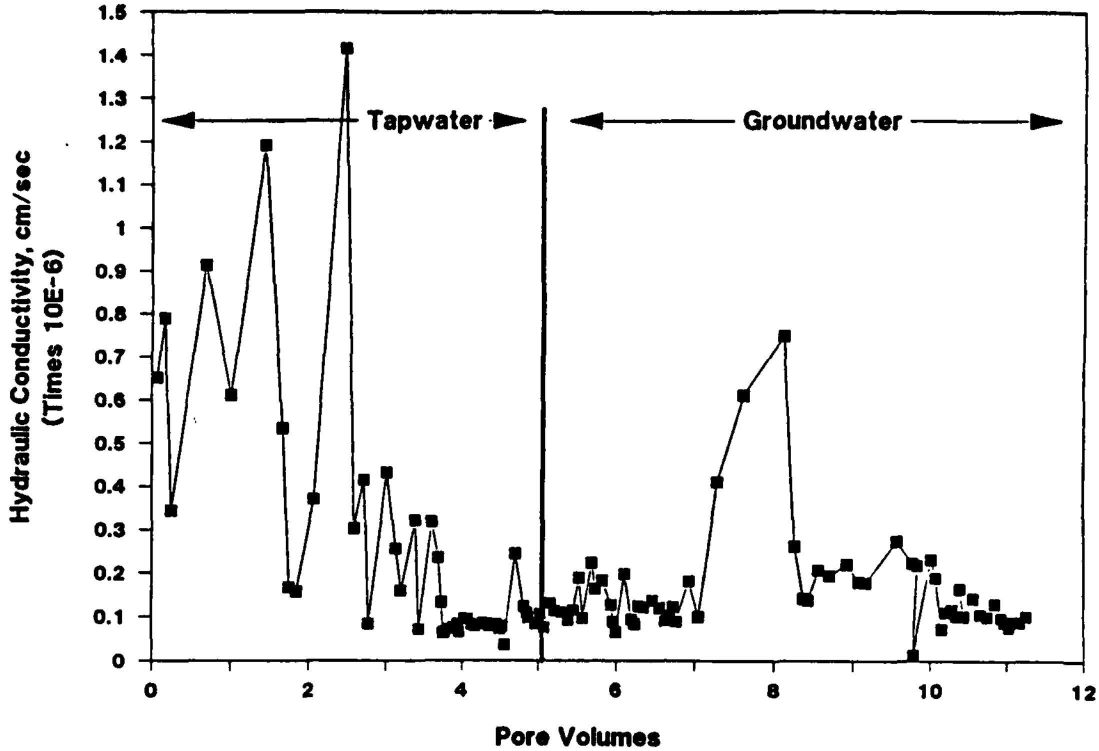


Figure C29. Cell 13 hydraulic conductivity data

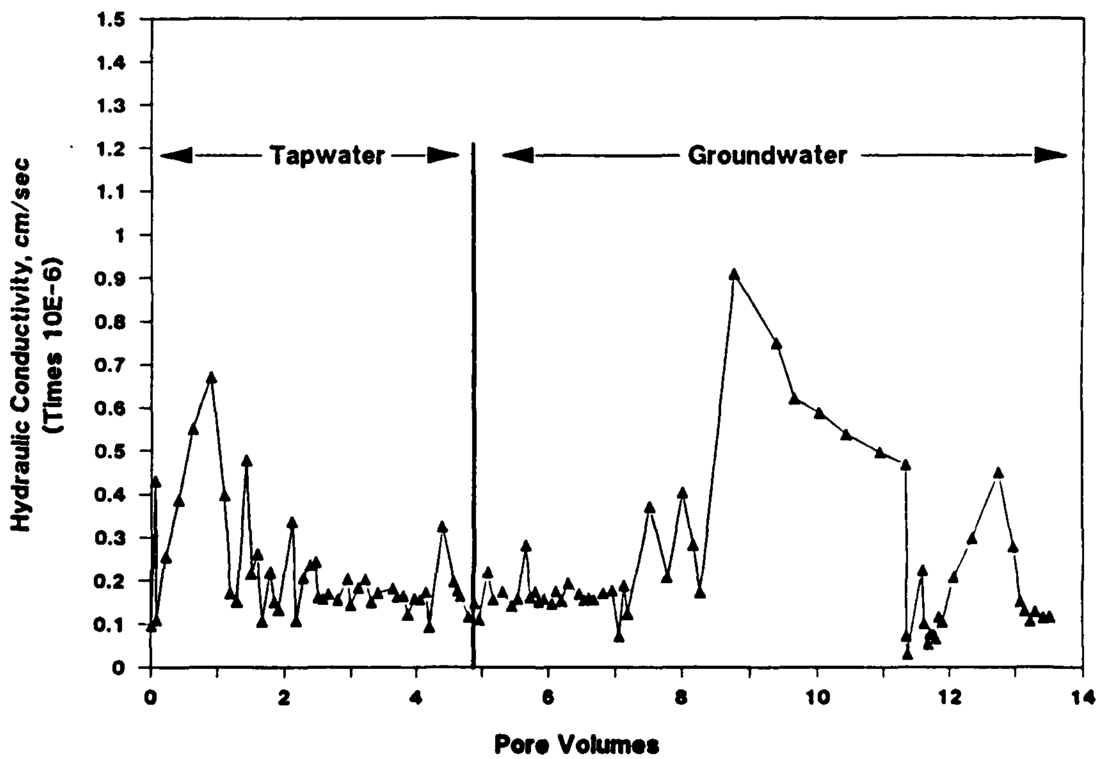


Figure C30. Cell 14 hydraulic conductivity data

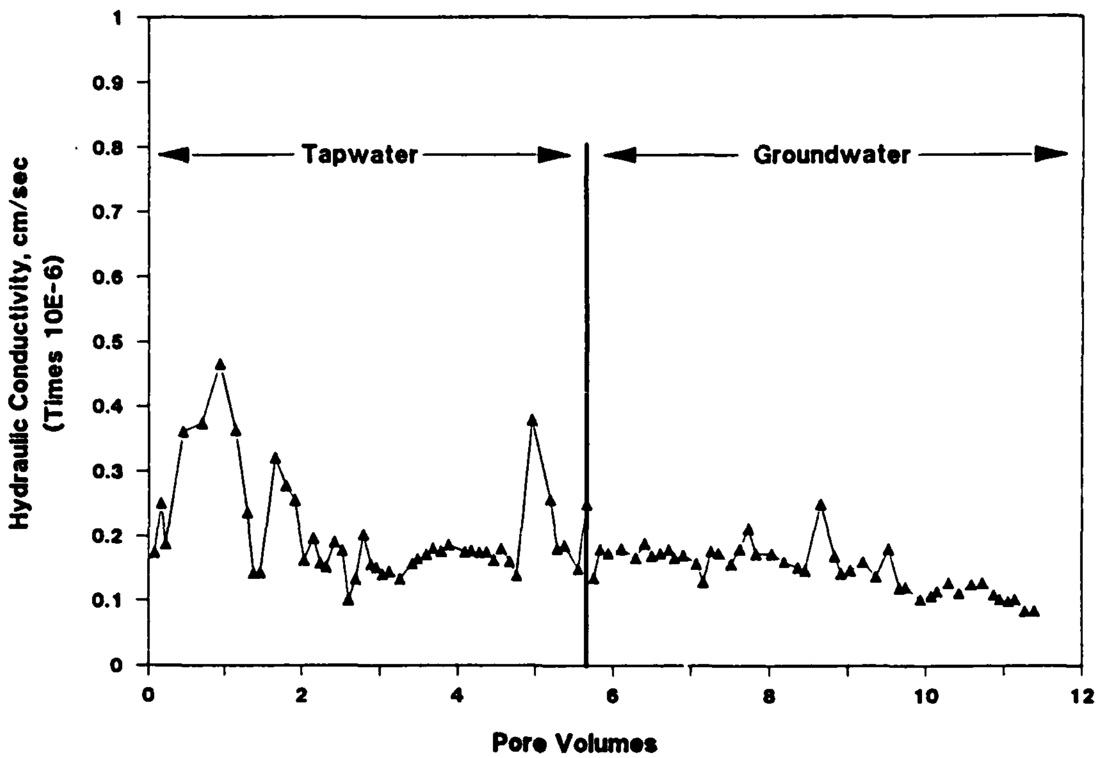


Figure C31. Cell 15 hydraulic conductivity data

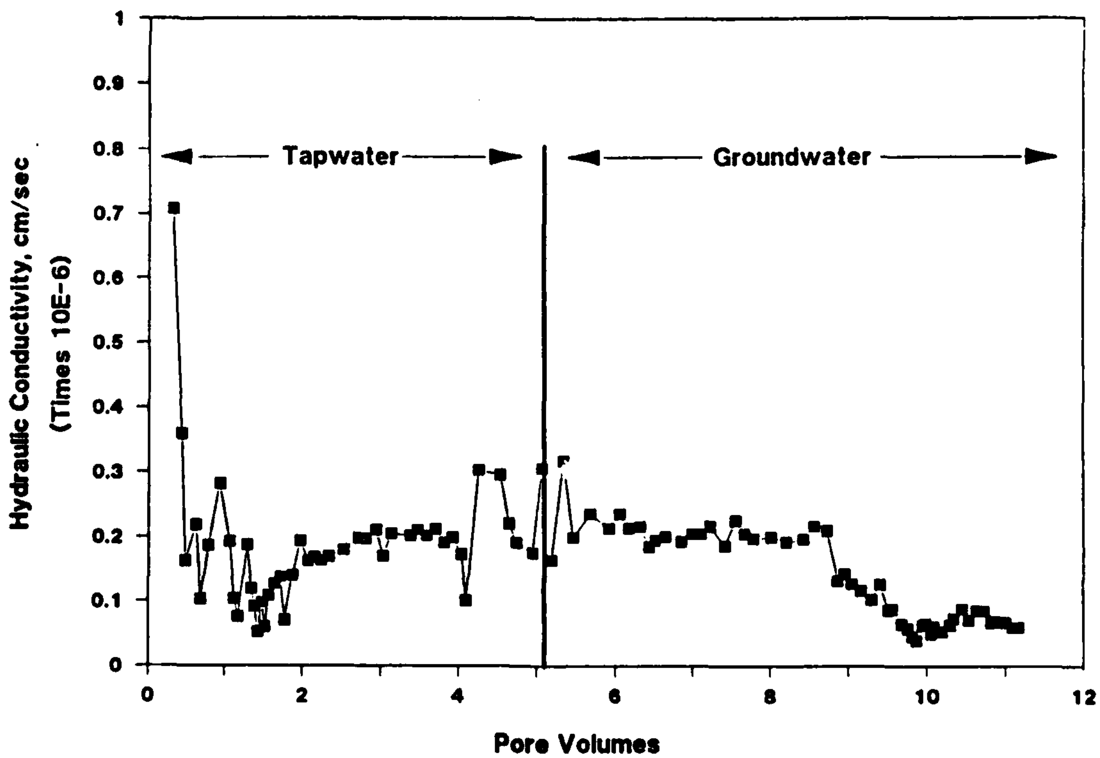


Figure C32. Cell 16 hydraulic conductivity data

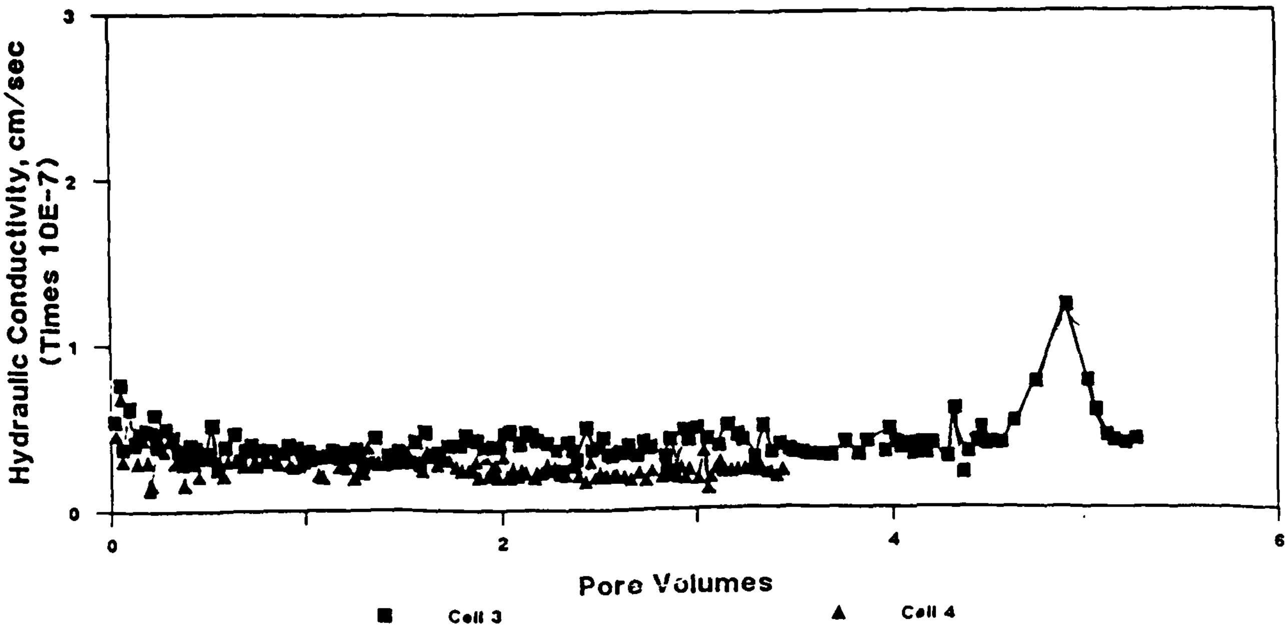


Figure C33. Cells 1 and 2 hydraulic conductivity data (expanded plot)

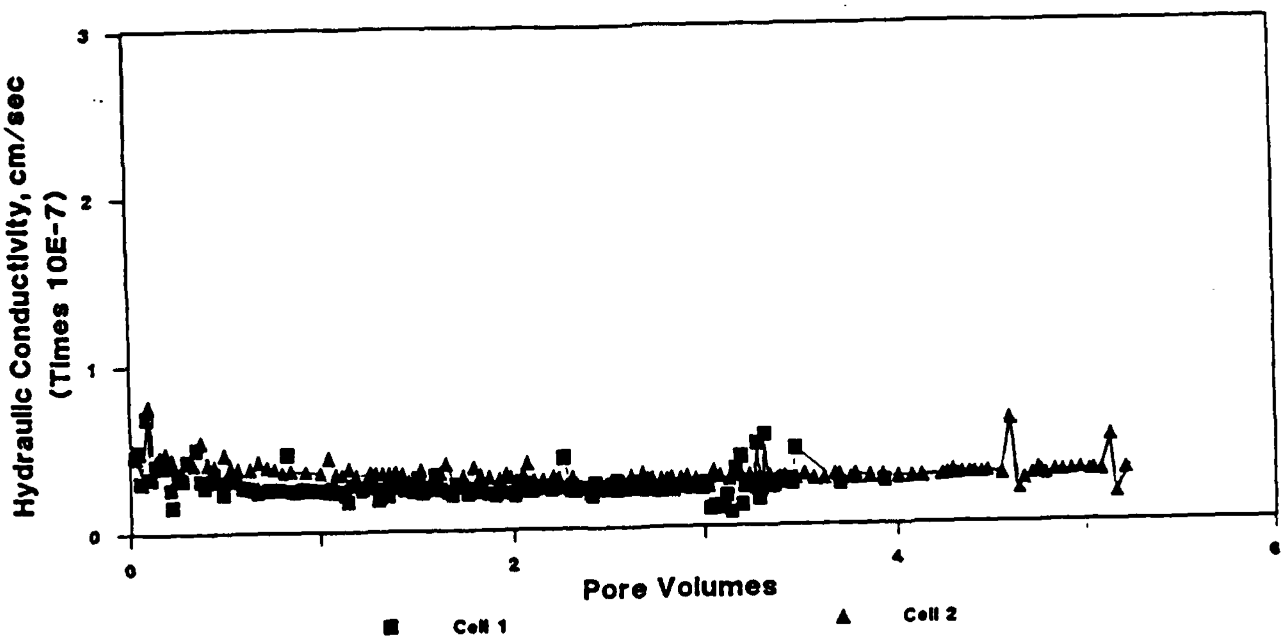


Figure C34. Cells 3 and 4 hydraulic conductivity data (expanded plot)

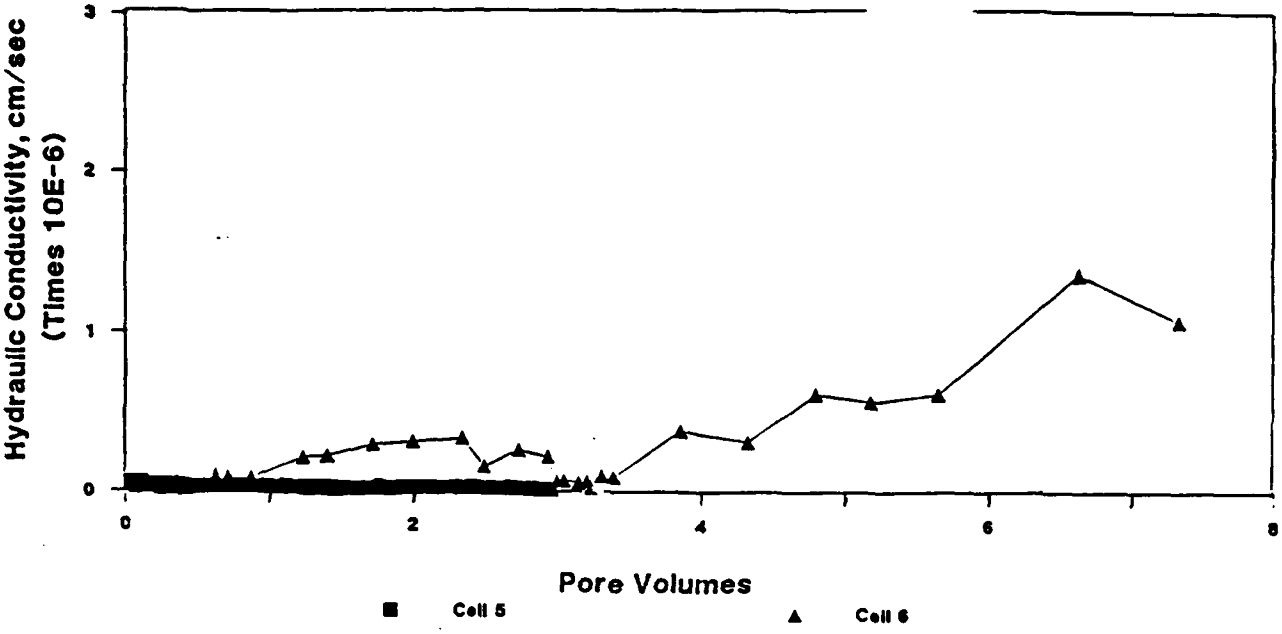


Figure C35. Cells 5 and 6 hydraulic conductivity data (expanded plot)

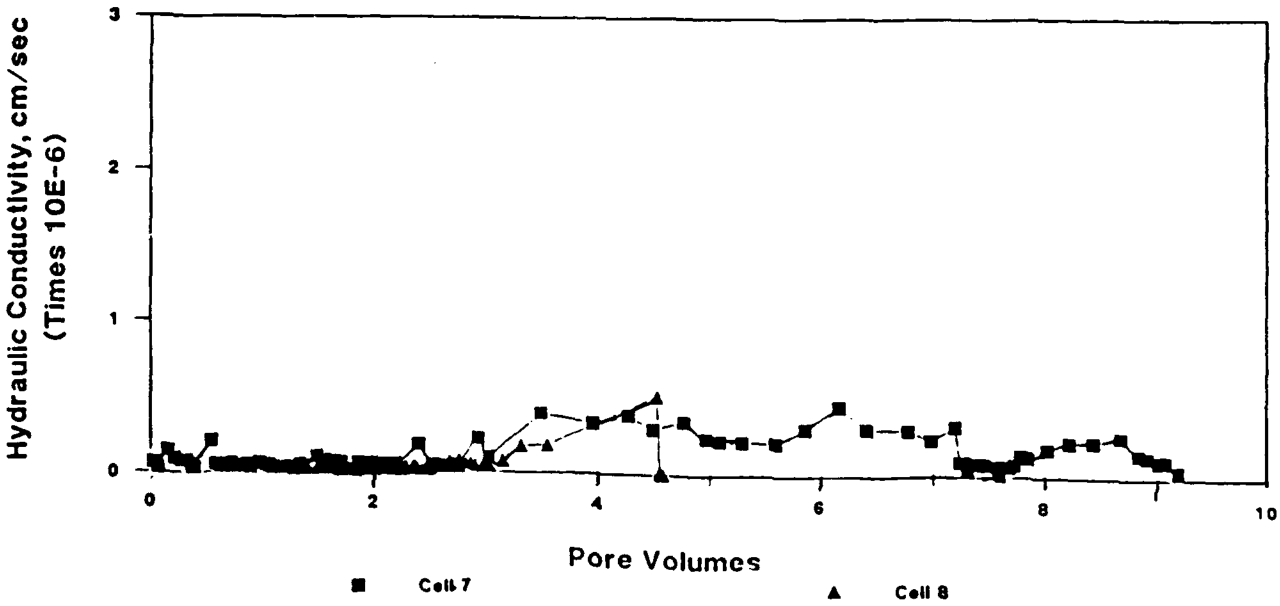


Figure C36. Cells 7 and 8 hydraulic conductivity data (expanded plot)

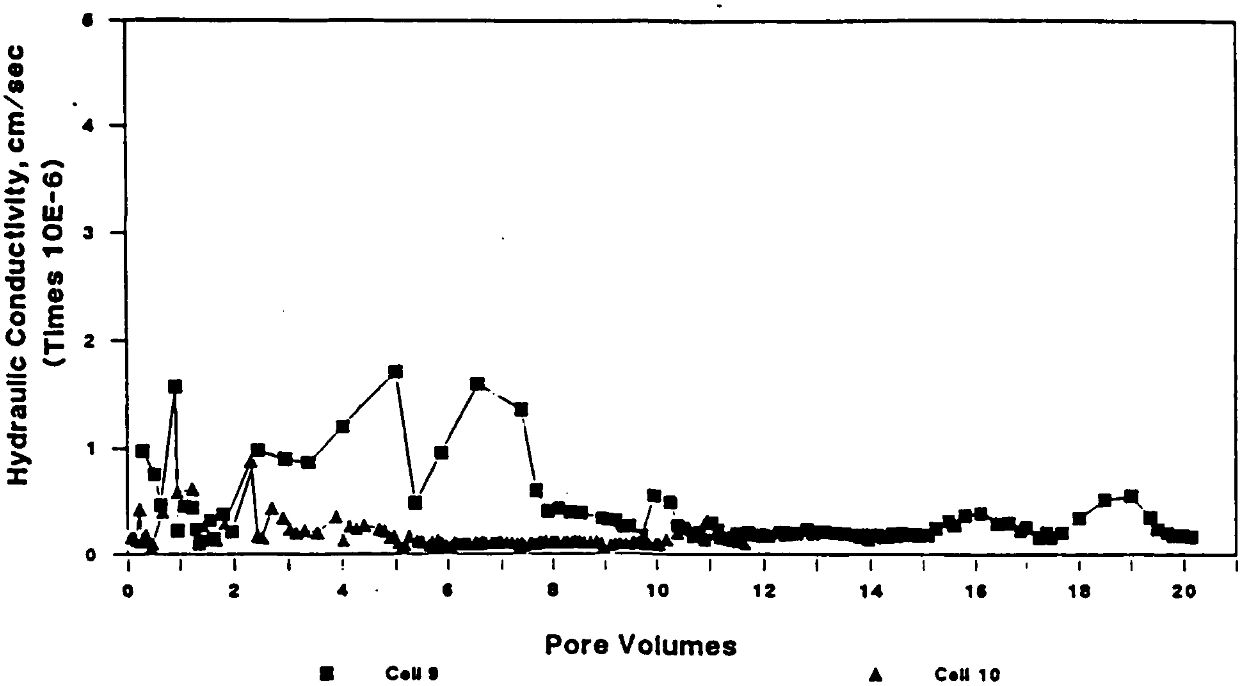


Figure C37. Cells 9 and 10 hydraulic conductivity data (expanded plot)

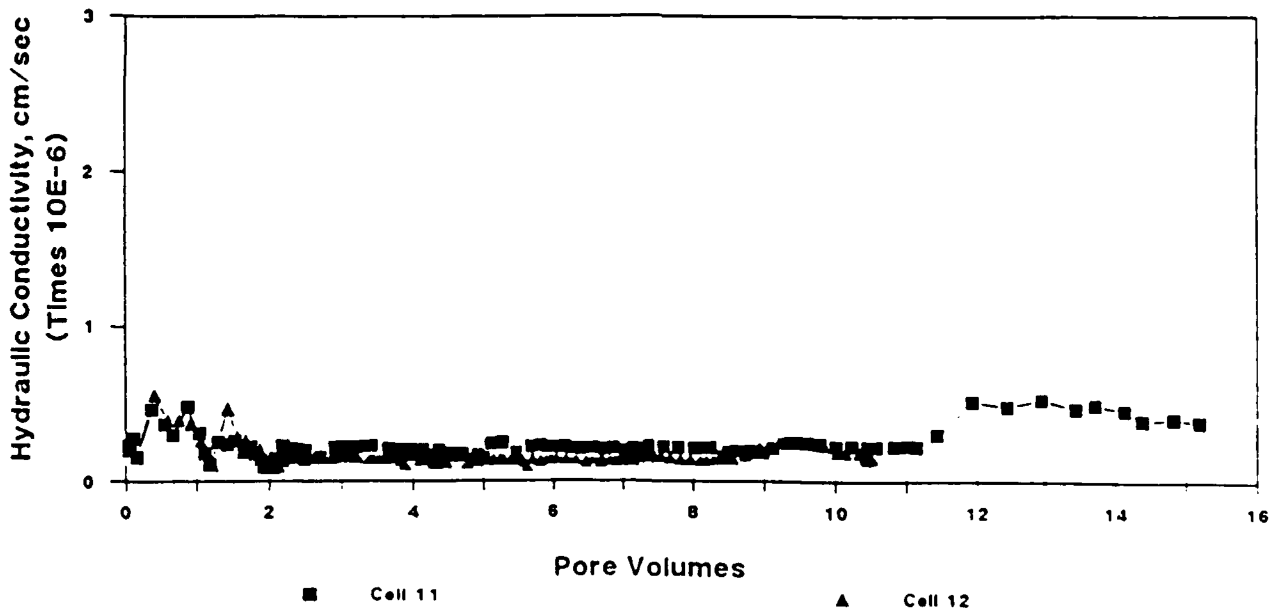


Figure C38. Cells 11 and 12 hydraulic conductivity data (expanded plot)

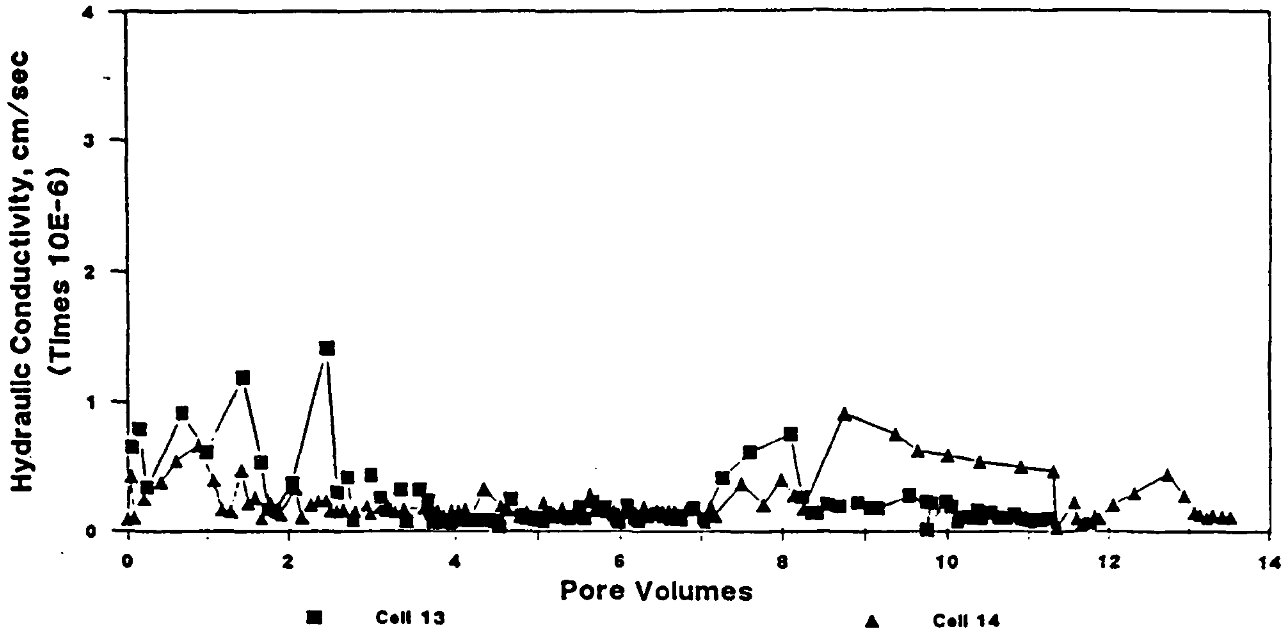


Figure C39. Cells 13 and 14 hydraulic conductivity data (expanded plot)

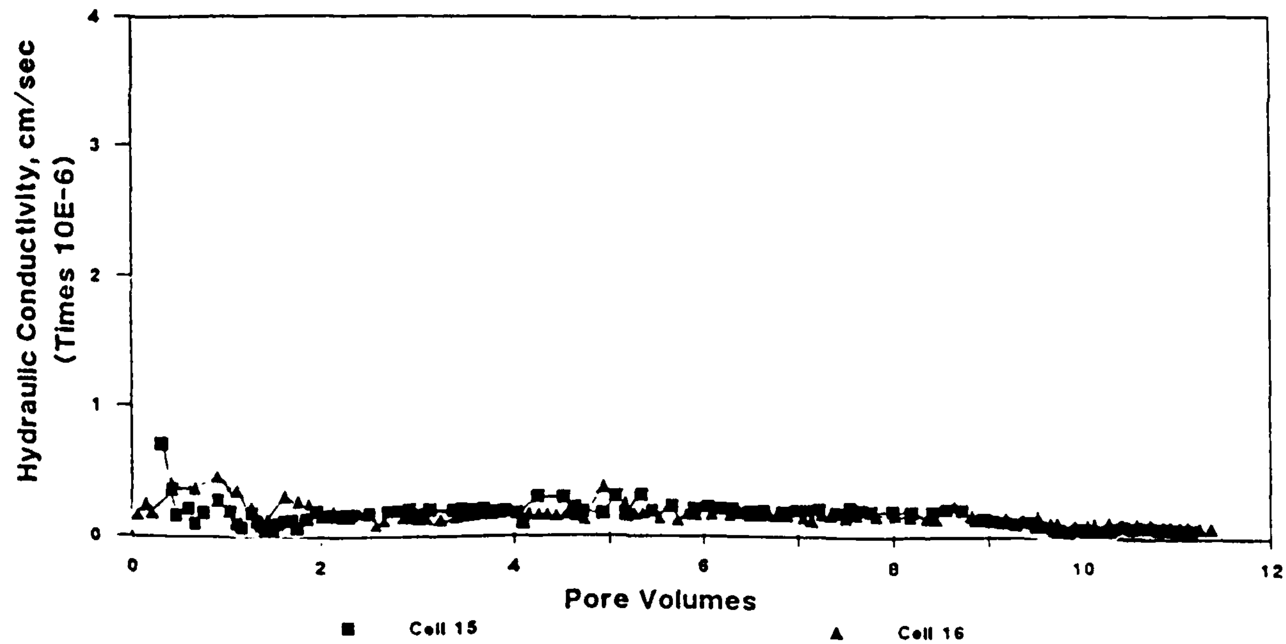


Figure C40. Cells 15 and 16 hydraulic conductivity data (expanded plot)

APPENDIX D: PERMEABILITY DATA FOR CELLS 1 THROUGH 16

Table D1

Ninth Avenue Permeameter Cell 1 Data

Date	Time	Time Increment hrs	Head ft H_2O	Hydraulic Gradient i	Volume Leached cm^3	Permeability K cm/sec	# PV Leached
OCT 28	14.25	0.0	2.2	11.8	0.0	Start-up	
29	14.92	24.7	3.5	18.7	6.0	4.60E-08	0.0
30	17.25	26.3	2.5	13.7	5.0	4.89E-08	0.0
31	13.42	20.2	2.7	14.3	2.5	3.06E-08	0.1
NOV 1	12.75	23.3	4.0	21.8	10.0	6.94E-08	0.1
2	13.17	24.4	4.0	21.8	5.0	3.32E-08	0.1
3	12.00	22.8	5.0	26.8	7.0	4.04E-08	0.1
4	12.67	24.7	4.9	26.5	8.0	4.33E-08	0.2
5	17.17	28.5	4.6	24.9	8.0	3.98E-08	0.2
6	17.50	24.3	5.1	27.4	5.0	2.65E-08	0.2
7	13.67	20.2	5.1	27.4	2.5	1.60E-08	0.2
8	13.25	23.6	6.0	32.4	7.5	3.47E-08	0.2
9	13.08	23.8	6.0	32.4	7.0	3.20E-08	0.3
10	11.25	22.2	4.8	26.2	7.0	4.26E-08	0.3
11	17.75	30.5	5.1	27.7	12.0	5.01E-08	0.3
12	17.17	23.4	6.2	33.4	7.0	3.17E-08	0.4
13	16.00	22.8	5.1	27.7	5.0	2.79E-08	0.4
14	11.92	19.9	5.2	28.1	5.0	3.16E-08	0.4
15	12.25	24.3	6.1	32.7	8.0	3.55E-08	0.4
16	13.50	25.3	6.3	34.3	7.5	3.06E-08	0.5
17	13.92	24.4	6.3	34.3	5.5	2.32E-08	0.5
18	13.67	23.8	7.8	42.4	9.0	3.16E-08	0.5
19	11.25	21.6	7.8	42.1	8.0	3.11E-08	0.6
20	14.50	27.3	7.9	42.7	9.0	2.73E-08	0.6
21	12.25	21.8	7.8	42.4	7.0	2.68E-08	0.6
22	12.25	24.0	7.8	42.4	7.5	2.61E-08	0.6
23	15.62	27.4	7.8	42.3	8.0	2.44E-08	0.7
25	15.50	47.9	7.7	41.8	14.5	2.56E-08	0.7
27	14.55	47.1	7.8	42.1	14.5	2.59E-08	0.8
28	11.16	20.6	7.8	42.4	11.5	4.65E-08	0.8
29	13.33	26.2	7.6	40.8	7.5	2.48E-08	0.9
30	11.25	21.9	7.3	39.6	6.0	2.44E-08	0.9
DEC 1	12.25	25.0	6.9	37.4	7.0	2.65E-08	0.9
2	12.75	24.5	7.5	40.5	7.0	2.49E-08	0.9
4	18.30	53.6	6.9	37.4	14.0	2.47E-08	1.0
5	12.67	18.4	7.1	38.3	5.0	2.51E-08	1.0
6	13.33	24.7	7.2	39.0	6.5	2.39E-08	1.0
7	13.25	23.9	7.2	38.7	7.0	2.68E-08	1.0
8	13.50	24.3	6.8	36.8	6.0	2.38E-08	1.1
9	13.25	23.8	7.2	39.0	6.5	2.48E-08	1.1
10	14.08	24.8	7.8	42.4	6.5	2.18E-08	1.1
11	12.58	22.5	8.1	43.6	5.0	1.80E-08	1.1

(Continued)

Table D1 (Continued)

Date	Time	Time Increment hrs	Head ft H_2O	Hydraulic Gradient i	Volume Leached cm^3	Permeability K cm/sec	# PV Leached
DEC 12	8.25	19.7	7.2	38.7	6.0	2.79E-08	1.2
14	13.42	53.2	6.9	37.4	14.0	2.49E-08	1.2
15	12.67	23.3	6.9	37.1	6.5	2.66E-08	1.2
16	8.40	19.7	5.8	31.2	5.0	2.87E-08	1.3
18	12.33	51.9	7.2	38.7	11.0	1.94E-08	1.3
19	13.50	25.2	7.2	38.7	7.0	2.54E-08	1.3
20	13.67	24.2	6.5	34.9	5.0	2.10E-08**	1.3
21	13.25	23.6	6.2	33.7	6.5	2.89E-08	1.4
22	16.75	27.5	6.4	34.6	7.0	2.60E-08	1.4
24	10.08	41.3	6.4	34.6	10.0	2.47E-08	1.4
26	10.33	48.3	6.3	34.3	11.0	2.35E-08	1.5
27	12.25	25.9	6.3	34.3	8.0	3.18E-08	1.5
28	10.83	22.6	6.4	34.6	5.0	2.26E-08	1.5
29	13.83	27.0	6.4	34.6	6.5	2.46E-08	1.5
30	17.17	27.3	6.4	34.6	7.0	2.62E-08	1.6
31	11.92	18.8	5.2	28.4	5.0	3.32E-08	1.6
JAN 1	19.00	31.1	6.4	34.6	7.5	2.47E-08	1.6
3	15.58	44.6	6.4	34.6	10.0	2.29E-08	1.7
4	17.42	25.8	6.6	35.5	5.5	2.12E-08	1.7
5	15.67	22.3	6.5	34.9	6.0	2.73E-08	1.7
6	17.83	26.2	6.4	34.6	7.0	2.73E-08	1.7
8	11.92	42.1	6.4	34.6	9.0	2.19E-08	1.8
9	15.00	27.1	6.2	33.7	6.5	2.52E-08	1.8
10	15.58	24.6	6.5	34.9	6.0	2.47E-08	1.8
11	16.25	24.7	6.3	34.3	5.5	2.30E-08	1.8
13	16.58	48.3	6.5	34.9	10.5	2.20E-08	1.9
15	12.17	43.6	6.5	34.9	9.0	2.09E-08	1.9
17	14.58	50.4	6.5	34.9	11.0	2.21E-08	1.9
18	17.58	27.0	6.5	34.9	6.0	2.25E-08	2.0
19	16.25	22.7	6.5	34.9	5.0	2.23E-08	2.0
20	16.00	23.8	6.7	36.2	5.0	2.06E-08	2.0
22	11.67	43.7	6.5	35.2	10.0	2.30E-08	2.0
23	13.50	25.8	6.5	34.9	7.0	2.74E-08	2.1
24	15.92	26.4	6.5	34.9	6.0	2.30E-08	2.1
25	16.50	24.6	6.5	34.9	6.0	2.47E-08	2.1
26	16.25	23.8	6.5	34.9	6.0	2.56E-08	2.1
27	17.12	24.9	6.2	33.7	6.0	2.53E-08	2.2
29	11.58	42.5	6.5	34.9	10.0	2.38E-08	2.2
30	15.83	28.3	6.5	34.9	7.0	2.51E-08	2.2
31	15.50	23.7	6.5	34.9	10.0	4.28E-08	2.3
FEB 2	12.25	44.8	6.5	34.9	10.0	2.26E-08	2.3

(Continued)

(Sheet 2 of 4)

Table D1 (Continued)

Date	Time	Time Increment hrs	Head ft H_2O	Hydraulic Gradient i	Volume Leached cm^3	Permeability K cm/sec	# PV Leached
FEB 3	17.42	29.2	6.5	34.9	6.5	2.26E-08	2.3
5	12.00	42.6	6.5	34.9	10.0	2.38E-08	2.4
8	9.30	69.3	6.5	34.9	13.0	1.90E-08	2.4
9	10.83	25.5	5.3	28.7	5.5	2.66E-08	2.4
10	17.17	30.3	6.3	34.0	7.0	2.40E-08	2.5
12	12.25	43.1	6.3	34.0	10.0	2.42E-08	2.5
13	10.42	22.2	6.3	34.3	5.5	2.56E-08	2.5
14	16.67	30.3	6.2	33.7	8.0	2.78E-08	2.5
16	9.17	40.5	6.3	34.3	9.0	2.29E-08	2.6
18	10.50	49.3	6.3	34.0	11.0	2.32E-08	2.6
20	10.08	47.6	6.3	34.3	11.0	2.38E-08	2.7
22	8.17	46.1	6.3	34.0	10.0	2.26E-08	2.7
23	8.17	24.0	6.4	34.6	5.5	2.34E-08	2.7
25	17.42	57.2	6.3	34.3	12.0	2.16E-08	2.8
27	9.08	39.7	6.3	34.3	9.5	2.47E-08	2.8
MAR 1	8.17	47.1	6.3	34.3	10.0	2.19E-08	2.8
3	11.33	51.2	6.3	34.3	12.0	2.42E-08	2.9
5	13.92	50.6	6.3	34.3	11.5	2.34E-08	2.9
6	10.50	20.6	6.3	34.0	5.0	2.53E-08	2.9
8	16.75	54.3	6.3	34.3	12.0	2.28E-08	3.0
9	16.42	23.7	6.3	34.3	6.0	2.61E-08	3.0
12	16.00	71.6	6.3	34.3	16.0	1.10E-08	3.0
15	11.00	67.0	6.3	34.0	15.0	1.27E-08	3.0
18	14.83	75.8	6.3	34.3	16.0	1.12E-08	3.1
21	12.75	69.9	6.3	34.3	15.0	1.31E-08	3.1
23	13.13	48.4	6.3	34.3	11.0	1.84E-08	3.1
27	16.25	99.1	6.3	34.0	21.5	8.56E-08	3.1
28	16.17	23.9	6.2	33.7	6.0	3.47E-08	3.2
29	14.92	22.8	6.2	33.7	5.5	4.16E-08	3.2
30	15.17	24.3	5.4	29.0	5.0	1.26E-08	3.2
31	16.83	25.7	5.4	29.3	5.0	2.35E-08	3.2
APR 2	13.33	43.5	5.4	29.3	9.0	2.50E-08	3.2
3	16.92	27.6	5.3	28.7	6.0	2.68E-08	3.2
5	8.42	39.5	5.4	29.3	8.0	2.44E-08	3.2
6	15.50	31.1	5.4	28.9	6.5	2.56E-08	3.2
10	10.25	90.8	5.4	29.3	17.0	2.26E-08	3.3
11	8.17	21.9	5.5	29.6	9.0	4.90E-08	3.3
14	9.25	73.1	5.5	29.6	10.0	1.63E-08	3.3
15	13.33	28.1	6.6	35.9	6.0	2.11E-08	3.3
17	9.00	19.7	5.5	29.6	9.0	5.46E-08	3.3
18	14.33	29.3	5.4	29.0	6.5	2.70E-08	3.3
19	13.50	23.2	5.5	29.9	5.0	2.55E-08	3.3

(Continued)

(Sheet 3 of 4)

Table D1 (Concluded)

Date	Time	Time Increment hrs	Head ft H_2O	Hydraulic Gradient i	Volume Leached cm^3	Permeability K cm/sec	# PV Leached
20	14.00	24.5	5.5	29.9	5.0	2.41E-08	3.3
22	12.08	46.1	5.5	29.6	9.0	2.33E-08	3.4
24	10.00	45.9	5.5	29.6	10.0	2.60E-08	3.4
26	11.50	49.5	5.4	29.0	10.5	2.59E-08	3.4
28	8.42	44.9	5.4	29.0	10.0	2.72E-08	3.4
30	11.17	50.8	5.4	29.3	11.0	2.62E-08	3.4
MAY 1	13.37	26.2	5.5	29.6	6.0	2.73E-08	3.4
3	8.17	42.8	5.5	29.6	9.0	2.51E-08	3.4
4	14.20	30.0	5.5	29.6	11.5	4.57E-08	3.5
6	17.58	51.4	5.8	31.2	11.0	2.43E-08	3.7
8	16.5	46.9	5.7	30.6	10.5	2.59E-08	3.9

(Sheet 4 of 4)

Table D2

Ninth Avenue Permeameter Cell 2 Data

Date	Time	Time Increment hrs	Head ft H_2O	Hydraulic Gradient i	Volume Leached cm^3	Permeability K cm/sec	# PV Leached
OCT 28	14.25	0.0	2.2	11.8	0.0	Start-up	
29	14.92	24.7	3.5	18.7	6.0	4.60E-08	0.0
30	17.25	26.3	2.5	13.7	5.0	4.89E-08	0.0
31	13.42	20.2	2.7	14.3	2.5	3.06E-08	0.1
NOV 1	12.75	23.3	4.0	21.8	11.0	7.64E-08	0.1
2	13.17	24.4	4.0	21.8	6.0	3.98E-08	0.1
3	12.00	22.8	5.0	26.8	8.0	4.62E-08	0.1
4	12.67	24.7	4.9	26.5	9.0	4.87E-08	0.2
5	17.17	28.5	4.6	24.9	9.0	4.48E-08	0.2
6	17.50	24.3	5.1	27.4	7.0	3.71E-08	0.2
7	13.67	20.2	5.1	27.4	6.0	3.83E-08	0.3
8	13.25	23.6	6.0	32.4	9.5	4.39E-08	0.3
9	13.08	23.8	6.0	32.4	9.0	4.12E-08	0.3
10	11.25	22.2	4.8	26.2	9.0	5.48E-08	0.4
11	17.75	30.5	5.1	27.7	10.0	4.18E-08	0.4
12	17.17	23.4	6.2	33.4	9.0	4.07E-08	0.4
13	16.00	22.8	5.1	27.7	6.0	3.35E-08	0.5
14	11.92	19.9	5.2	28.1	7.5	4.74E-08	0.5
15	12.25	24.3	6.1	32.7	9.0	4.00E-08	0.5
16	13.50	25.3	6.3	34.3	9.5	3.88E-08	0.6
17	13.92	24.4	6.3	34.3	7.0	2.96E-08	0.6
18	13.67	23.8	7.8	42.4	11.0	3.86E-08	0.6
19	11.25	21.6	7.8	42.1	11.0	4.28E-08	0.7
20	14.50	27.3	7.9	42.7	13.0	3.95E-08	0.7
21	12.25	21.8	7.8	42.4	10.0	3.83E-08	0.8
22	13.75	25.5	7.8	42.4	11.0	3.60E-08	0.8
23	15.62	25.9	7.8	42.3	11.5	3.72E-08	0.8
25	15.50	47.9	7.7	41.8	20.5	3.62E-08	0.9
27	14.55	47.1	7.8	42.1	20.0	3.57E-08	1.0
28	11.17	20.6	7.8	42.4	11.0	4.45E-08	1.0
29	13.33	26.2	7.6	40.8	10.5	3.48E-08	1.1
30	11.25	21.9	7.3	39.6	8.5	3.46E-08	1.1
DEC 1	12.25	25.0	6.9	37.4	10.0	3.78E-08	1.1
2	12.75	24.5	7.5	40.5	9.5	3.38E-08	1.2
4	18.30	53.6	6.9	37.4	20.0	3.53E-08	1.2
5	12.67	18.4	7.1	38.3	7.0	3.51E-08	1.3
6	13.33	24.7	7.2	39.0	9.5	3.50E-08	1.3
7	13.25	23.9	7.2	38.7	9.0	3.44E-08	1.3
8	13.50	24.3	6.8	36.8	9.0	3.57E-08	1.4
9	13.25	23.8	7.2	39.0	9.0	3.44E-08	1.4
10	14.08	24.8	7.8	42.4	9.0	3.02E-08	1.4
11	12.58	22.5	8.1	43.6	8.0	2.88E-08	1.5

(Continued)

(Sheet 1 of 4)

Table D2 (Continued)

Date	Time	Time Increment hrs	Head ft H_2O	Hydraulic Gradient i	Volume Leached cm^3	Permeability K cm/sec	# PV Leached
DEC 12	8.25	19.7	7.2	38.7	8.0	3.72E-08	1.5
14	13.42	53.2	6.9	37.4	19.0	3.38E-08	1.6
15	12.67	23.3	6.9	37.1	8.5	3.48E-08	1.6
16	8.40	19.7	5.8	31.2	7.0	4.02E-08	1.6
18	12.33	51.9	7.2	38.7	15.0	2.64E-08	1.7
19	13.50	25.2	7.2	38.7	9.0	3.27E-08	1.7
20	13.67	24.2	6.5	34.9	6.0	2.51E-08	1.7
21	13.25	23.6	6.2	33.7	8.5	3.79E-08	1.8
22	16.75	27.5	6.4	34.6	9.0	3.34E-08	1.8
24	10.08	41.3	6.4	34.6	13.0	3.21E-08	1.9
26	10.33	48.3	6.3	34.3	14.5	3.10E-08	1.9
27	12.25	25.9	6.3	34.3	8.5	3.38E-08	1.9
28	10.83	22.6	6.4	34.6	7.0	3.17E-08	2.0
29	13.83	27.0	6.4	34.6	8.0	3.03E-08	2.0
30	17.17	27.3	6.4	34.6	9.0	3.36E-08	2.0
31	11.92	18.8	5.2	28.4	6.0	3.99E-08	2.1
JAN 1	19.00	31.1	6.4	34.6	9.0	2.96E-08	2.1
3	15.58	44.6	6.4	34.6	13.0	2.98E-08	2.1
4	17.42	25.8	6.6	35.5	7.0	2.70E-08	2.2
5	15.67	22.3	6.5	34.9	7.0	3.19E-08	2.2
6	17.83	26.2	6.4	34.6	8.0	3.12E-08	2.2
8	11.92	42.1	6.4	34.6	11.0	2.67E-08	2.3
9	15.00	27.1	6.2	33.7	8.0	3.10E-08	2.3
10	15.58	24.6	6.5	34.9	6.5	2.68E-08	2.3
11	16.25	24.7	6.3	34.3	6.0	2.51E-08	2.3
13	16.58	48.3	6.5	34.9	10.0	2.10E-08	2.4
15	12.17	43.6	6.5	34.9	10.0	2.32E-08	2.4
17	14.58	50.4	6.5	34.9	11.5	2.31E-08	2.5
18	17.58	27.0	6.5	34.9	7.0	2.63E-08	2.5
19	16.25	22.7	6.5	34.9	6.0	2.68E-08	2.5
20	16.00	23.8	6.7	36.2	5.5	2.26E-08	2.5
22	11.67	43.7	6.5	35.2	11.5	2.64E-08	2.6
23	13.50	25.8	6.5	34.9	8.0	3.14E-08	2.6
24	15.92	26.4	6.5	34.9	7.5	2.88E-08	2.6
25	16.50	24.6	6.5	34.9	8.0	3.30E-08	2.7
26	16.25	23.8	6.5	34.9	7.0	2.98E-08	2.7
27	17.12	24.9	6.2	33.7	7.0	2.96E-08	2.7
29	11.58	42.5	6.5	34.9	12.0	2.86E-08	2.8
30	15.83	28.3	6.5	34.9	8.0	2.87E-08	2.8
31	15.50	23.7	6.5	34.9	7.0	2.99E-08	2.8
FEB 2	12.25	44.8	6.5	34.9	13.0	2.94E-08	2.9

(Continued)

(Sheet 2 of 4)

Table D2 (Continued)

Date	Time	Time Increment hrs	Head ft H_2O	Hydraulic Gradient i	Volume Leached cm^3	Permeability K cm/sec	# PV Leached
FEB 3	17.42	29.2	6.5	34.9	9.0	3.12E-08	2.9
5	12.00	42.6	6.5	34.9	12.0	2.85E-08	2.9
8	9.50	69.5	6.5	34.9	17.0	2.48E-08	3.0
9	10.83	25.3	5.3	28.7	7.0	3.41E-08	3.0
10	17.17	30.3	6.3	34.0	9.0	3.09E-08	3.1
12	12.25	43.1	6.3	34.0	12.0	2.90E-08	3.1
13	10.42	22.2	6.3	34.3	7.0	3.26E-08	3.1
14	16.67	30.3	6.2	33.7	9.0	3.12E-08	3.2
16	9.17	40.5	6.3	34.3	12.0	3.06E-08	3.2
18	10.50	49.3	6.3	34.0	14.0	2.95E-08	3.3
20	10.08	47.6	6.3	34.3	14.0	3.03E-08	3.3
22	8.17	46.1	6.3	34.0	13.0	2.94E-08	3.4
23	8.17	24.0	6.4	34.6	7.0	2.98E-08	3.4
25	17.42	57.3	6.3	34.3	16.0	2.88E-08	3.5
27	9.08	39.7	6.3	34.3	12.0	3.12E-08	3.5
MAR 1	8.17	47.1	6.3	34.3	13.0	2.85E-08	3.6
3	11.33	51.2	6.3	34.3	14.0	2.82E-08	3.6
5	13.92	50.6	6.3	34.3	15.0	3.06E-08	3.7
6	10.50	20.6	6.3	34.0	6.0	3.03E-08	3.7
8	16.75	54.3	6.3	34.3	15.0	2.85E-08	3.7
9	16.42	23.7	6.3	34.3	7.0	3.05E-08	3.8
12	16.00	71.6	6.3	34.3	20.0	2.88E-08	3.8
15	11.00	67.0	6.3	34.0	19.0	2.95E-08	3.9
18	14.83	75.8	6.3	34.3	21.0	2.86E-08	4.0
21	12.75	69.9	6.3	34.3	19.5	2.88E-08	4.1
23	13.13	48.4	6.3	34.3	13.5	2.88E-08	4.1
27	16.25	99.1	6.3	34.0	28.0	2.94E-08	4.2
28	16.17	23.9	6.2	33.7	7.0	3.07E-08	4.2
29	14.92	22.8	6.2	33.7	7.0	3.23E-08	4.3
30	15.17	24.3	5.4	29.0	6.0	3.02E-08	4.3
31	16.83	25.7	5.4	29.3	6.5	3.06E-08	4.3
APR 2	13.33	43.5	5.4	29.3	11.0	3.05E-08	4.4
3	16.92	27.6	5.3	28.7	7.0	3.13E-08	4.4
5	8.42	39.5	5.4	29.3	10.0	3.05E-08	4.4
6	15.50	31.1	5.4	28.9	8.0	3.15E-08	4.5
10	10.25	90.8	5.4	29.3	22.0	2.93E-08	4.5
11	8.17	21.9	5.5	29.6	11.5	6.26E-08	4.6
14	9.25	73.1	5.5	29.6	12.5	2.04E-08	4.6
15	13.33	28.1	6.6	35.9	7.5	2.63E-08	4.7
17	9.00	43.7	5.5	29.6	11.0	3.01E-08	4.7
18	14.33	29.3	5.4	29.0	8.0	3.33E-08	4.7
19	13.50	23.2	5.5	29.9	6.0	3.06E-08	4.8

(Continued)

(Sheet 3 of 4)

Table D2 (Concluded)

Date	Time	Time Increment hrs	Head ft H_2O	Hydraulic Gradient i	Volume Leached cm^3	Permeability K cm/sec	# PV Leached
20	14.00	24.5	5.5	29.9	6.0	2.89E-08	4.8
22	12.08	46.1	5.5	29.6	12.0	3.11E-08	4.8
24	10.00	45.9	5.5	29.6	12.0	3.12E-08	4.9
26	11.50	49.5	5.4	29.0	13.0	3.20E-08	4.9
28	8.42	44.9	5.4	29.0	12.0	3.26E-08	5.0
30	11.17	50.8	5.4	29.3	13.0	3.09E-08	5.0
MAY 1	13.37	26.2	5.5	29.6	7.0	3.19E-08	5.0
3	8.17	42.8	5.5	29.6	11.0	3.07E-08	5.1
4	14.20	30.0	5.5	29.6	13.0	5.17E-08	5.1
6	17.58	51.4	5.8	31.2	8.0	1.77E-08	5.2
8	16.50	46.9	5.7	30.6	13.0	3.21E-08	5.2

(Sheet 4 of 4)

Table D3

Ninth Avenue Permeameter Cell 3 Data

Date	Time	Time Increment hrs	Head ft H_2O	Hydraulic Gradient i	Volume Leached cm^3	Permeability K cm/sec	# PV Leached
OCT 28	14.25	0.0	2.4	13.1	0.0	Start-up	
29	14.92	24.7	2.9	15.9	6.0	5.41E-08	0.0
30	17.25	26.3	2.6	14.0	8.0	7.66E-08	0.1
31	13.42	20.2	2.1	11.5	2.5	3.80E-08	0.1
NOV 1	12.75	23.3	4.5	24.3	10.0	6.23E-08	0.1
2	13.17	24.4	4.5	24.3	7.0	4.17E-08	0.1
3	12.00	22.8	4.3	23.1	7.0	4.70E-08	0.2
4	12.67	24.7	4.8	26.2	9.0	4.93E-08	0.2
5	17.17	28.5	3.3	18.1	7.0	4.80E-08	0.2
6	17.50	24.3	2.3	12.5	5.0	5.83E-08	0.2
7	13.67	20.2	2.1	11.2	2.5	3.90E-08	0.2
8	13.25	23.6	6.7	36.2	12.0	4.98E-08	0.3
9	13.08	23.8	6.2	33.4	10.0	4.45E-08	0.3
10	11.25	22.2	5.7	30.6	7.0	3.65E-08	0.3
11	17.75	30.5	5.9	32.1	9.0	3.25E-08	0.4
12	17.17	23.4	6.3	34.0	9.0	4.00E-08	0.4
13	16.00	22.8	5.3	28.7	7.0	3.78E-08	0.4
14	11.92	19.9	4.7	25.6	5.0	3.47E-08	0.5
15	12.25	24.3	6.2	33.7	8.0	3.45E-08	0.5
16	13.50	25.3	4.5	24.3	9.0	5.18E-08	0.5
17	13.92	24.4	7.5	40.5	7.0	2.50E-08	0.6
18	13.67	23.8	7.9	42.7	11.0	3.83E-08	0.6
19	11.25	21.6	7.8	42.4	12.0	4.64E-08	0.6
20	14.50	27.3	6.3	34.0	8.0	3.05E-08	0.7
21	12.25	21.8	5.8	31.2	7.0	3.65E-08	0.7
22	13.75	25.5	5.5	29.6	8.5	3.98E-08	0.7
23	15.62	25.9	6.4	34.4	9.5	3.64E-08	0.8
25	15.50	47.9	6.6	35.5	17.0	3.61E-08	0.8
27	14.55	47.1	6.5	35.2	16.0	3.41E-08	0.9
28	11.17	20.6	6.5	34.9	8.0	3.93E-08	0.9
29	13.33	26.2	6.7	36.2	10.0	3.74E-08	1.0
30	11.25	21.9	6.6	35.5	7.5	3.40E-08	1.0
DEC 1	12.25	25.0	6.7	36.2	9.0	3.52E-08	1.0
2	12.75	24.5	6.7	36.5	8.0	3.17E-08	1.0
4	18.30	53.6	6.7	36.5	18.0	3.26E-08	1.1
5	12.67	18.4	6.9	37.1	7.0	3.63E-08	1.1
6	13.33	24.7	6.9	37.1	8.0	3.09E-08	1.2
7	13.25	23.9	6.7	36.2	8.5	3.47E-08	1.2
8	13.50	24.3	6.7	36.5	8.0	3.20E-08	1.2
9	13.25	23.8	5.9	32.1	8.0	3.71E-08	1.3
10	14.08	24.8	8.1	43.6	8.0	2.61E-08	1.3
11	12.58	22.5	7.2	38.7	7.0	2.85E-08	1.3

(Continued)

(Sheet 1 of 4)

Table D3 (Continued)

Date	Time	Time Increment hrs	Head ft H_2O	Hydraulic Gradient i	Volume Leached cm^3	Permeability K cm/sec	# PV Leached
12	8.25	19.7	7.6	41.2	10.0	4.37E-08	1.4
14	13.42	53.2	6.3	34.3	17.0	3.30E-08	1.4
15	12.67	23.3	6.1	33.0	7.0	3.22E-08	1.4
16	8.40	19.7	6.5	34.9	7.0	3.59E-08	1.5
18	12.33	51.9	6.5	34.9	15.0	2.93E-08	1.5
19	13.50	25.2	5.0	27.1	8.0	4.14E-08	1.6
20	13.67	24.2	6.0	32.4	6.0	2.71E-08	1.6
21	13.25	23.6	4.1	22.1	7.0	4.74E-08	1.6
22	16.75	27.5	5.1	27.4	7.0	3.28E-08	1.6
24	10.08	41.3	5.0	26.8	11.0	3.51E-08	1.7
26	10.33	48.3	4.5	24.3	13.0	3.92E-08	1.7
27	12.25	25.9	5.1	27.7	8.0	3.93E-08	1.8
28	10.83	22.6	5.1	27.7	7.0	3.95E-08	1.8
29	13.83	27.0	4.8	25.9	9.0	4.55E-08	1.8
30	17.17	27.3	5.0	27.1	9.0	4.29E-08	1.8
31	11.92	18.8	5.0	26.8	6.0	4.22E-08	1.9
JAN 1	19.00	31.1	5.1	27.4	9.0	3.73E-08	1.9
3	15.58	44.6	5.0	26.8	13.0	3.85E-08	2.0
4	17.42	25.8	5.2	28.4	8.0	3.86E-08	2.0
5	15.67	22.3	5.1	27.4	8.0	4.63E-08	2.0
6	17.83	26.2	3.6	19.6	7.0	4.82E-08	2.0
8	11.92	42.1	5.1	27.4	13.0	3.98E-08	2.1
9	15.00	27.1	4.6	24.9	9.0	4.71E-08	2.1
10	15.58	24.6	4.4	23.7	7.5	4.55E-08	2.1
11	16.25	24.7	4.4	23.7	7.0	4.23E-08	2.2
13	16.58	48.3	4.7	25.3	14.0	4.06E-08	2.2
15	12.17	43.6	5.0	26.8	12.0	3.63E-08	2.3
17	14.58	50.4	4.8	26.2	9.0	2.41E-08	2.3
18	17.58	27.0	4.7	25.6	8.0	4.10F-08	2.3
19	16.25	22.7	4.8	26.2	6.0	3.57E-08	2.4
20	16.00	23.8	5.4	29.3	6.0	3.05E-08	2.4
22	11.67	43.7	4.2	22.8	14.0	4.98E-08	2.4
23	13.50	25.8	4.9	26.5	7.0	3.62E-08	2.5
24	15.92	26.4	4.8	26.2	7.5	3.83E-08	2.5
25	16.50	24.6	4.8	26.2	8.0	4.39E-08	2.5
26	16.20	23.7	4.9	26.5	6.0	3.38E-08	2.5
27	17.12	24.9	4.8	26.2	6.0	3.25E-08	2.6
29	11.58	42.5	4.6	24.6	10.5	3.55E-08	2.6
30	15.83	28.3	4.7	25.6	7.0	3.43E-08	2.6
31	15.50	23.7	3.9	21.2	5.5	3.88E-08	2.7
FEB 2	12.25	44.8	4.9	26.5	11.0	3.28E-08	2.7
3	17.42	29.2	4.6	24.9	8.5	4.13E-08	2.7

(Continued)

(Sheet 2 of 4)

Table D3 (Continued)

Date	Time	Time Increment hrs	Head ft H_2O	Hydraulic Gradient i	Volume Leached cm^3	Permeability K cm/sec	# PV Leached
5	12.00	42.6	4.1	22.1	10.0	3.75E-08	2.8
8	9.50	69.5	5.8	31.2	19.5	3.18E-08	2.8
9	10.83	25.3	4.6	24.6	7.5	4.25E-08	2.9
10	17.17	30.3	5.2	28.1	5.5	2.28E-08	2.9
12	12.25	43.1	4.3	23.1	13.5	4.80E-08	2.9
13	10.42	22.2	4.9	26.5	7.0	4.21E-08	3.0
14	16.67	30.3	4.8	26.2	11.0	4.91E-08	3.0
16	9.17	40.5	5.1	27.7	13.5	4.25E-08	3.1
18	10.50	49.3	5.0	27.1	14.5	3.83E-08	3.1
20	10.08	47.6	3.8	20.6	14.0	5.06E-08	3.2
22	8.17	46.1	3.8	20.6	12.0	4.47E-08	3.2
23	8.17	24.0	4.6	24.9	7.0	4.14E-08	3.2
25	17.42	57.3	6.0	32.4	16.0	3.05E-08	3.3
27	9.08	39.7	4.0	21.5	12.0	4.97E-08	3.3
MAR 1	8.17	47.1	4.5	24.3	11.0	3.40E-08	3.4
3	11.33	51.2	4.0	21.5	12.0	3.86E-08	3.4
5	13.92	50.6	4.4	23.7	12.0	3.54E-08	3.5
6	10.50	20.6	4.7	25.6	5.0	3.36E-08	3.5
8	16.75	54.3	4.7	25.6	13.0	3.31E-08	3.5
9	16.42	23.7	5.2	28.1	6.0	3.19E-08	3.6
12	16.00	71.6	4.8	26.2	17.0	3.21E-08	3.6
15	11.00	67.0	5.1	27.4	16.5	3.17E-08	3.7
18	14.83	75.8	4.2	22.4	19.0	3.95E-09	3.8
21	12.75	69.9	5.2	28.1	18.0	3.24E-08	3.8
23	13.13	48.4	4.0	21.8	12.0	4.02E-08	3.9
27	16.25	99.1	4.8	26.2	25.0	3.41E-08	4.0
28	16.17	23.9	4.0	21.8	7.0	4.74E-08	4.0
29	14.92	22.8	4.7	25.6	6.5	3.95E-08	4.0
30	15.17	24.3	5.2	28.1	7.0	3.64E-08	4.0
31	16.83	25.7	5.0	26.8	7.5	3.85E-08	4.1
APR 2	13.33	43.5	4.6	24.9	10.0	3.26E-08	4.1
3	16.92	27.6	4.3	23.1	7.0	3.89E-08	4.1
5	8.42	39.5	5.3	28.7	10.5	3.29E-08	4.2
6	15.50	31.1	4.3	23.4	8.0	3.88E-08	4.2
10	10.25	90.8	5.0	26.8	21.0	3.05E-08	4.3
11	8.17	21.9	5.5	29.6	11.0	5.99E-08	4.4
14	9.25	73.1	4.9	26.5	11.5	2.10E-08	4.4
15	13.33	28.1	4.8	26.2	7.0	3.37E-08	4.4
17	9.00	43.7	4.0	21.5	10.5	3.95E-08	4.4
18	14.33	29.3	3.9	21.2	8.5	4.83E-08	4.5
19	13.50	23.2	4.4	24.0	6.0	3.81E-08	4.5
20	14.00	24.5	4.7	25.3	7.0	4.00E-08	4.5

(Continued)

(Sheet 3 of 4)

Table D3 (Concluded)

Date	Time	Time Increment hrs	Head ft H_2O	Hydraulic Gradient i	Volume Leached cm^3	Permeability K cm/sec	# PV Leached
22	12.08	46.1	5.1	27.4	14.0	3.92E-08	4.6
24	10.00	45.9	5.2	28.1	19.0	5.21E-08	4.6
26	11.50	49.5	5.3	28.7	30.5	7.60E-08	4.7
28	8.42	44.9	5.1	27.7	43.0	1.22E-07	4.9
30	11.17	50.8	5.1	27.4	30.0	7.62E-08	5.0
MAY 1	13.37	26.2	5.1	27.7	12.0	5.84E-08	5.1
3	8.17	42.8	5.1	27.4	14.5	4.37E-08	5.1
4	14.20	30.0	5.1	27.7	9.5	4.03E-08	5.2
6	17.58	51.4	5.2	28.4	16.0	3.88E-08	5.2
8	16.50	46.9	4.9	26.5	14.5	4.12E-08	5.3

(Sheet 4 of 4)

Table D4

Ninth Avenue Permeameter Cell 4 Data

Date	Time	Time Increment hrs	Head ft H_2O	Hydraulic Gradient i	Volume Leached cm^3	Permeability K cm/sec	# PV Leached
OCT 28	14.25	0.0	2.2	11.8	0.0	Start-up	
29	14.92	24.7	3.5	18.7	6.0	4.60E-08	0.0
30	17.25	26.3	2.5	13.7	7.0	6.85E-08	0.0
31	13.42	20.2	2.7	14.3	2.5	3.06E-08	0.1
NOV 1	12.75	23.3	4.0	21.8	9.0	6.25E-08	0.1
2	13.17	24.4	4.0	21.8	6.0	3.98E-08	0.1
3	12.00	22.8	5.0	26.8	5.0	2.89E-08	0.1
4	12.67	24.7	4.9	26.5	8.0	4.33E-08	0.2
5	17.17	28.5	4.6	24.9	6.0	2.98E-08	0.2
6	17.50	24.3	5.1	27.4	2.5	1.32E-08	0.2
7	13.67	20.2	5.1	27.4	2.5	1.60E-08	0.2
8	13.25	23.6	6.0	32.4	10.0	4.62E-08	0.2
9	13.08	23.8	6.0	32.4	8.0	3.66E-08	0.3
10	11.25	22.2	4.8	26.2	7.0	4.26E-08	0.3
11	17.75	30.5	5.1	27.7	7.0	2.92E-08	0.3
12	17.17	23.4	6.2	33.4	7.0	3.17E-08	0.4
13	16.00	22.8	5.1	27.7	5.0	2.79E-08	0.4
14	11.92	19.9	5.2	28.1	2.5	1.58E-08	0.4
15	12.25	24.3	6.1	32.7	7.5	3.33E-08	0.4
16	13.50	25.3	6.3	34.3	7.0	2.86E-08	0.4
17	13.92	24.4	6.3	34.3	5.0	2.11E-08	0.5
18	13.67	23.8	7.8	42.4	9.0	3.16E-08	0.5
19	11.25	21.6	7.8	42.1	9.0	3.50E-08	0.5
20	14.50	27.3	7.9	42.7	9.5	2.89E-08	0.6
21	12.25	21.8	7.8	42.4	5.5	2.11E-08	0.6
22	13.75	25.5	5.5	29.6	6.5	3.04E-08	0.6
23	15.62	25.9	6.4	34.4	7.5	2.98E-08	0.6
25	15.50	47.9	6.6	35.5	13.0	2.70E-08	0.7
27	14.55	47.1	6.5	35.2	13.0	2.77E-08	0.7
28	11.17	20.6	6.5	34.9	5.5	2.70E-08	0.7
29	13.33	26.2	6.7	36.2	8.0	2.99E-08	0.8
30	11.25	21.9	6.6	35.5	6.5	2.95E-08	0.8
DEC 1	12.25	25.0	6.7	36.2	8.0	3.13E-08	0.8
2	12.75	24.5	6.7	36.5	7.0	2.77E-08	0.9
4	18.30	53.6	6.7	36.5	15.0	2.72E-08	0.9
5	12.67	18.4	6.9	37.1	5.0	2.59E-08	0.9
6	13.33	24.7	6.9	37.1	7.0	2.71E-08	1.0
7	13.25	23.9	6.7	36.2	7.0	2.86E-08	1.0
8	13.50	24.3	6.7	36.5	7.5	3.00E-08	1.0
9	13.25	23.8	5.9	32.1	7.0	3.25E-08	1.0
10	14.08	24.8	8.1	43.6	6.5	2.12E-08	1.1
11	12.58	22.5	7.2	38.7	5.0	2.03E-08	1.1

(Continued)

(Sheet 1 of 4)

Table D4 (Continued)

Date	Time	Time Increment hrs	Head ft H_2O	Hydraulic Gradient i	Volume Leached cm^3	Permeability K cm/sec	# PV Leached
12	8.25	19.7	7.6	41.2	8.0	3.49E-08	1.1
14	13.42	53.2	6.3	34.3	13.5	2.62E-08	1.2
15	12.67	23.3	6.1	33.0	6.0	2.76E-08	1.2
16	8.40	19.7	6.5	34.9	5.0	2.57E-08	1.2
18	12.33	51.9	6.5	34.9	10.0	1.95E-08	1.2
19	13.50	25.2	5.0	27.1	7.0	3.63E-08	1.3
20	13.67	24.2	6.0	32.4	5.0	2.26E-08	1.3
21	13.25	23.6	4.1	22.1	5.5	2.73E-08	1.3
22	16.75	27.5	5.1	27.4	6.0	2.81E-08	1.3
24	10.08	41.3	5.0	26.8	8.5	2.71E-08	1.4
26	10.33	48.3	4.5	24.3	9.0	2.71E-08	1.4
27	12.25	25.9	5.1	27.7	7.0	3.44E-08	1.4
28	10.83	22.6	5.1	27.7	5.0	2.82E-08	1.4
29	13.83	27.0	4.8	25.9	6.0	3.04E-08	1.5
30	17.17	27.3	5.0	27.1	6.0	2.86E-08	1.5
31	11.92	18.8	5.0	26.8	5.0	3.52E-08	1.5
JAN 1	19.00	31.1	5.1	27.4	7.0	2.96E-08	1.5
3	15.58	44.6	5.0	26.8	10.0	2.96E-08	1.6
4	17.42	25.8	5.2	28.4	5.0	2.41E-08	1.6
5	15.67	22.3	5.1	27.4	6.0	3.48E-08	1.6
6	17.83	26.2	3.6	19.6	5.0	3.44E-08	1.6
8	11.92	42.1	5.1	27.4	9.0	2.76E-08	1.7
9	15.00	27.1	4.6	24.9	6.0	3.14E-08	1.7
10	15.58	24.6	4.4	23.7	5.0	3.04E-08	1.7
11	16.25	24.7	4.4	23.7	5.0	3.02E-08	1.7
13	16.58	48.3	4.7	25.3	9.0	2.61E-08	1.8
15	12.17	43.6	5.0	26.8	8.0	2.42E-08	1.8
17	14.58	50.4	4.8	26.2	9.0	2.41E-08	1.8
18	17.58	27.0	4.7	25.6	5.0	2.56E-08	1.8
19	16.25	22.7	4.8	26.2	5.0	2.98E-08	1.9
20	16.00	23.8	5.4	29.3	4.0	2.03E-08	1.9
22	11.67	43.7	4.2	22.8	9.0	3.20E-08	1.9
23	13.50	25.8	4.9	26.5	4.0	2.07E-08	1.9
24	15.92	26.4	4.8	26.2	5.0	2.56E-08	1.9
25	16.50	24.6	4.8	26.2	5.0	2.75E-08	2.0
26	16.25	23.8	4.9	26.5	3.5	1.97E-08	2.0
27	17.12	24.9	4.8	26.2	6.0	3.26E-08	2.0
29	11.58	42.5	4.6	24.6	6.0	2.03E-08	2.0
30	15.83	28.3	4.7	25.6	4.0	1.96E-08	2.0
31	15.50	23.7	3.9	21.2	3.5	2.47E-08	2.0

(Continued)

(Sheet 2 of 4)

Table D4 (Continued)

Date	Time	Time Increment hrs	Head ft H_2O	Hydraulic Gradient i	Volume Leached cm^3	Permeability K cm/sec	# PV Leached
FEB 2	12.25	44.8	4.9	26.5	7.0	2.09E-08	2.1
3	17.42	29.2	4.6	24.9	5.0	2.43E-08	2.1
5	12.00	42.6	4.1	22.1	6.0	2.25E-08	2.1
8	9.30	69.3	5.8	31.2	12.0	1.96E-08	2.2
9	10.83	25.5	4.6	24.6	4.0	2.25E-08	2.2
10	17.17	30.3	5.2	28.1	5.5	2.28E-08	2.2
12	12.25	43.1	4.3	23.1	8.0	2.85E-08	2.2
13	10.42	22.2	4.9	26.5	4.0	2.41E-08	2.2
14	16.67	30.3	4.8	26.2	6.0	2.68E-08	2.3
16	9.17	40.5	5.1	27.7	7.0	2.20E-08	2.3
18	10.50	49.3	5.0	27.1	8.0	2.11E-08	2.3
20	10.08	47.6	3.8	20.6	8.0	2.89E-08	2.3
22	8.17	46.1	3.8	20.6	7.0	2.61E-08	2.4
23	8.17	24.0	4.6	24.9	3.5	2.07E-08	2.4
25	17.42	57.3	6.0	32.4	9.0	1.71E-08	2.4
27	9.08	39.7	4.0	21.5	7.0	2.90E-08	2.4
MAR 1	8.17	47.1	4.5	24.3	6.5	2.01E-08	2.5
3	11.33	51.2	4.0	21.5	7.0	2.25E-08	2.5
5	13.92	50.6	4.4	23.7	7.0	2.06E-08	2.5
6	10.50	20.6	4.7	25.6	3.0	2.02E-08	2.5
8	16.75	54.3	4.7	25.6	8.0	2.04E-08	2.6
9	16.42	23.7	5.2	28.1	4.0	2.13E-08	2.6
12	16.00	71.6	4.8	26.2	10.5	1.98E-08	2.6
15	11.00	67.0	5.1	27.4	9.5	1.83E-08	2.7
18	14.83	75.8	4.2	22.4	11.0	2.29E-08	2.7
21	12.75	69.9	5.2	28.1	10.0	1.80E-08	2.7
23	13.13	48.4	4.0	21.8	7.0	2.34E-08	2.8
27	16.25	99.1	4.8	26.2	14.5	1.98E-08	2.8
28	16.17	23.9	4.0	21.8	4.0	2.71E-08	2.8
29	14.92	22.8	4.7	25.6	3.5	2.13E-08	2.8
30	15.17	24.3	5.2	28.1	4.0	2.08E-08	2.9
31	16.83	25.7	5.0	26.8	4.0	2.06E-08	2.9
APR 2	13.33	43.5	4.6	24.9	6.0	1.96E-08	2.9
3	16.92	27.6	4.3	23.1	4.5	2.50E-08	2.9
5	8.42	39.5	5.3	28.7	6.0	1.87E-08	2.9
6	15.50	31.1	4.3	23.4	5.0	2.43E-08	3.0
10	10.25	90.8	5.0	26.8	12.5	1.82E-08	3.0
11	8.17	21.9	5.5	29.6	6.5	3.54E-08	3.0
14	9.25	73.1	4.9	26.5	7.0	1.28E-08	3.1
15	13.33	28.1	4.8	26.2	4.0	1.92E-08	3.1
17	9.00	43.7	4.0	21.5	6.5	2.45E-08	3.1
18	14.33	29.3	3.9	21.2	5.0	2.84E-08	3.1

(Continued)

(Sheet 3 of 4)

Table D4 (Concluded)

Date	Time	Time Increment hrs	Head ft H_2O	Hydraulic Gradient i	Volume Leached cm^3	Permeability K cm/sec	# PV Leached
19	13.50	23.2	4.4	24.0	3.5	2.23E-08	3.1
20	14.00	24.5	4.7	25.3	4.0	2.29E-08	3.1
22	12.08	46.1	5.1	27.4	8.0	2.24E-08	3.2
24	10.00	45.9	5.2	28.1	8.5	2.33E-08	3.2
26	11.50	49.5	5.3	28.7	9.5	2.37E-08	3.2
28	8.42	44.9	5.1	27.7	9.0	2.55E-08	3.3
30	11.17	50.8	5.1	27.4	9.0	2.29E-08	3.3
MAY 1	13.37	26.2	5.1	27.7	5.0	2.43E-08	3.3
3	8.17	42.8	5.1	27.4	7.0	2.11E-08	3.3
4	14.20	30.0	5.1	27.7	5.0	2.12E-08	3.4
6	17.58	51.4	5.2	28.4	8.0	1.94E-08	3.4
8	16.5	46.9	4.9	26.5	8.0	2.28E-08	3.4

(Sheet 4 of 4)

Table D5

Ninth Avenue Permeameter Cell 5 Data

Date	Time	Time Increment hrs	Head ft H_2O	Hydraulic Gradient i	Volume Leached cm^3	Permeability K cm/sec	# PV Leached
OCT 28	14.25	0.0	3.0	16.2	0.0	Start-up	
29	14.92	24.7	3.7	20.0	8.0	5.75E-08	0.0
30	17.25	26.3	2.5	13.7	6.0	5.87E-08	0.1
31	13.42	20.2	3.2	17.5	2.5	2.51E-08	0.1
NOV 1	12.75	23.3	5.7	30.9	12.0	5.89E-08	0.1
2	13.17	24.4	5.8	31.5	7.0	3.22E-08	0.1
3	12.00	22.8	4.8	26.2	6.0	3.55E-08	0.2
4	12.67	24.7	4.3	23.4	7.0	4.29E-08	0.2
5	17.17	28.5	4.3	23.1	6.0	3.23E-08	0.2
6	17.50	24.3	4.8	26.2	5.0	2.77E-08	0.2
7	13.67	20.2	5.5	29.9	2.5	1.46E-08	0.2
8	13.25	23.6	5.0	26.8	7.5	4.19E-08	0.3
9	13.08	23.8	3.6	19.3	5.0	3.84E-08	0.3
10	11.25	22.2	2.8	15.0	2.5	2.66E-08	0.3
11	17.75	30.5	5.1	27.4	5.0	2.11E-08	0.3
12	17.17	23.4	5.0	26.8	6.0	3.38E-08	0.3
13	16.00	22.8	4.4	23.7	2.5	1.63E-08	0.3
14	11.92	19.9	4.7	25.6	2.5	1.74E-08	0.3
15	12.25	24.3	4.6	24.6	7.5	4.43E-08	0.4
16	13.50	25.3	3.7	20.0	6.0	4.21E-08	0.4
17	13.92	24.4	5.9	32.1	5.0	2.25E-08	0.4
18	13.67	23.8	7.2	38.7	9.0	3.47E-08	0.5
19	11.25	21.6	6.7	36.2	8.0	3.62E-08	0.5
20	14.50	27.3	6.6	35.9	8.5	3.08E-08	0.5
21	12.25	21.8	6.6	35.9	7.0	3.17E-08	0.5
22	13.75	25.5	5.5	29.6	7.5	3.51E-08	0.6
23	15.62	25.9	6.4	34.8	7.5	2.95E-08	0.6
25	15.50	47.9	6.5	35.2	13.5	2.83E-08	0.6
27	14.55	47.1	6.3	34.3	12.5	2.74E-08	0.7
28	11.17	20.6	6.3	34.0	6.0	3.03E-08	0.7
29	13.33	26.2	7.3	39.3	9.0	3.10E-08	0.8
30	11.25	21.9	7.2	38.7	8.0	3.34E-08	0.8
DEC 1	12.25	25.0	7.0	37.7	8.0	3.00E-08	0.8
2	12.75	24.5	7.3	39.6	8.0	2.92E-08	0.8
4	18.30	53.6	7.2	38.7	16.5	2.82E-08	0.9
5	12.67	18.4	7.0	38.0	6.0	3.04E-08	0.9
6	13.33	24.7	7.1	38.3	7.0	2.62E-08	1.0
7	13.25	23.9	6.6	35.5	8.0	3.33E-08	1.0
8	13.50	24.3	6.6	35.9	6.5	2.64E-08	1.0
9	13.25	23.8	7.2	39.0	7.0	2.67E-08	1.0
10	14.08	24.8	7.4	39.9	7.0	2.50E-08	1.1
11	12.58	22.5	7.4	39.9	5.5	2.17E-08	1.1

(Continued)

(Sheet 1 of 3)

Table D5 (Continued)

Date	Time	Time Increment hrs	Head ft H_2O	Hydraulic Gradient i	Volume Leached cm^3	Permeability K cm/sec	# PV Leached
DEC 12	8.25	19.7	8.6	46.5	9.0	3.48E-08	1.1
14	13.42	53.2	6.6	35.9	14.0	2.60E-08	1.2
15	12.67	23.3	6.5	35.2	6.0	2.69E-08	1.2
16	8.40	19.7	6.3	34.3	5.0	2.61E-08	1.2
18	12.33	51.9	6.7	36.5	9.5	1.77E-08	1.2
19	13.50	25.2	6.3	34.3	6.0	2.46E-08	1.3
20	13.67	24.2	6.9	37.4	2.5	9.78E-09	1.3
21	13.25	23.6	5.4	29.3	5.0	2.56E-08	1.3
22	16.75	27.5	5.4	29.0	5.0	2.22E-08	1.3
24	10.08	41.3	5.1	27.7	7.0	2.16E-08	1.3
26	10.33	48.3	5.4	29.0	7.0	1.77E-08	1.4
27	12.25	25.9	5.1	27.7	5.0	2.46E-08	1.4
28	10.83	22.6	5.5	29.9	2.5	1.31E-08	1.4
29	13.83	27.0	5.7	30.9	2.5	1.06E-08	1.4
30	17.17	27.3	5.5	29.9	5.0	2.16E-08	1.4
31	11.92	18.8	5.4	29.3	2.0	1.29E-08	1.4
JAN 1	19.00	31.1	5.4	29.3	5.0	1.94E-08	1.4
3	15.58	44.6	5.5	29.6	2.5	6.70E-09	1.5
4	17.42	25.8	6.0	32.4	2.0	8.44E-09	1.5
5	15.67	22.3	5.2	28.1	2.5	1.42E-08	1.5
6	17.83	26.2	5.1	27.4	2.5	1.23E-08	1.5
8	11.92	42.1	5.4	29.0	5.0	1.45E-08	1.5
9	15.00	27.1	5.1	27.4	3.0	1.43E-08	1.5
10	15.58	24.6	5.4	29.0	3.0	1.49E-08	1.5
11	16.25	24.7	6.1	32.7	4.5	1.97E-08	1.5
13	16.58	48.3	6.0	32.4	8.0	1.81E-08	1.6
15	12.17	43.6	6.0	32.4	7.0	1.75E-08	1.6
17	14.58	50.4	5.9	31.8	6.5	1.43E-08	1.6
18	17.58	27.0	6.0	32.4	4.0	1.62E-08	1.6
19	16.25	22.7	6.0	32.4	4.0	1.92E-08	1.7
20	16.00	23.8	6.7	36.5	3.5	1.43E-08	1.7
22	11.67	43.7	5.3	28.7	6.5	1.83E-08	1.7
23	13.50	25.8	5.3	28.7	3.0	1.43E-08	1.7
24	15.92	26.4	5.4	29.0	3.5	1.62E-08	1.7
25	16.50	24.6	5.4	29.3	3.0	1.47E-08	1.7
26	16.25	23.8	5.4	29.0	3.0	1.54E-08	1.7
27	17.12	24.9	5.3	28.7	6.0	2.97E-08	1.8
29	11.58	42.5	5.2	28.4	5.0	1.47E-08	1.8
30	15.83	28.3	5.3	28.7	4.0	1.75E-08	1.8
31	15.50	23.7	5.3	28.7	4.5	2.34E-08	1.8
FEB 2	12.25	44.8	5.1	27.7	7.0	1.99E-08	1.8
3	17.42	29.2	5.1	27.7	4.0	1.75E-08	1.9

(Continued)

(Sheet 2 of 3)

Table D5 (Concluded)

Date	Time	Time Increment hrs	Head ft H_2O	Hydraulic Gradient i	Volume Leached cm^3	Permeability K cm/sec	# PV Leached
5	12.00	42.6	5.2	28.1	5.0	1.48E-08	1.9
8	9.30	69.3	5.1	27.4	15.0	2.79E-08	1.9
9	10.83	25.5	5.3	28.7	4.0	1.93E-08	1.9
10	17.17	30.3	5.5	29.9	5.0	1.95E-08	2.0
12	12.25	43.1	5.1	27.4	7.0	2.09E-08	2.0
13	10.42	22.2	5.0	26.8	3.5	2.08E-08	2.0
14	16.67	30.3	5.7	30.6	6.0	2.30E-08	2.0
16	9.17	40.5	5.5	29.9	8.5	2.48E-08	2.1
18	10.50	49.3	5.5	29.9	10.5	2.51E-08	2.1
20	10.08	47.6	5.6	30.2	9.5	2.33E-08	2.1
22	8.17	46.1	5.3	28.7	9.0	2.41E-08	2.2
23	8.17	24.0	5.5	29.9	5.5	2.71E-08	2.2
25	17.42	57.3	6.6	35.9	17.0	2.93E-08	2.2
27	9.08	39.7	5.9	31.8	11.0	3.08E-08	2.3
MAR 1	8.17	47.1	4.4	23.7	7.5	2.38E-08	2.3
3	11.33	51.2	5.0	26.8	8.5	2.19E-08	2.3
5	13.92	50.6	4.8	26.2	8.5	2.27E-08	2.4
6	10.50	20.6	4.7	25.6	4.5	3.02E-08	2.4
8	16.75	54.3	4.6	24.9	9.5	2.48E-08	2.4
9	16.42	23.7	5.8	31.2	4.0	1.92E-08	2.4
12	16.00	71.6	5.1	27.4	10.5	1.89E-08	2.5
15	11.00	67.0	4.2	22.4	10.0	2.35E-08	2.5
18	14.83	75.8	4.7	25.6	9.5	1.73E-08	2.6
21	12.75	69.9	4.6	24.6	9.0	1.85E-08	2.6
23	13.13	48.4	4.6	24.6	6.0	1.78E-08	2.6
27	16.25	99.1	4.8	26.2	11.0	1.50E-08	2.7
28	16.17	23.9	3.7	20.0	3.5	2.59E-08	2.7
30	15.17	47.0	4.6	24.9	4.5	1.36E-08	2.7
31	16.83	25.7	5.8	31.2	3.5	1.55E-08	2.7
APR 2	13.13	43.3	5.9	31.8	6.0	1.54E-08	2.7
3	16.92	27.8	6.2	33.7	4.0	1.51E-08	2.7
5	8.42	39.5	5.0	26.8	5.5	1.84E-08	2.8
6	15.50	31.1	5.4	29.3	3.5	1.36E-08	2.8
10	10.25	90.8	4.9	26.6	9.0	1.32E-08	2.8
11	8.17	21.9	5.1	27.4	4.0	2.35E-08	2.8
14	9.25	73.1	5.1	27.7	4.5	7.85E-09	2.8
15	13.33	28.1	5.1	27.7	3.0	1.36E-08	2.9
17	9.00	43.7	5.0	27.1	4.0	1.19E-08	2.9
18	14.33	29.3	5.2	28.4	3.0	1.27E-08	2.9
20	14.00	47.7	6.2	33.7	3.5	7.71E-09	2.9
22	12.08	46.1	5.2	28.1	5.0	1.37E-08	2.9
24	10.00	45.9	4.2	22.8	3.5	1.18E-08	2.9
26	11.50	49.5	4.0	21.8	3.0	9.82E-09	2.9
28	8.42	44.9	4.3	23.1	3.5	1.19E-08	2.9

(Sheet 3 of 3)

Table D6

Ninth Avenue Permeameter Cell 6 Data

Date	Time	Time Increment hrs	Head ft H_2O	Hydraulic Gradient i	Volume Leached cm^3	Permeability K cm/sec	# PV Leached
OCT 28	14.25	0.0	3.0	16.2	0.0	Start-up	
29	14.92	24.7	3.7	20.0	8.0	5.75E-08	0.0
30	17.25	26.3	2.5	13.7	6.0	5.87E-08	0.1
31	13.42	20.2	3.2	17.5	2.5	2.51E-08	0.1
NOV 1	12.75	23.3	5.7	30.9	12.0	5.89E-08	0.1
2	13.17	24.4	5.8	31.5	7.0	3.22E-08	0.1
3	12.00	22.8	4.8	26.2	6.0	3.55E-08	0.2
4	12.67	24.7	4.3	23.4	7.0	4.29E-08	0.2
5	17.17	28.5	4.3	23.1	6.0	3.23E-08	0.2
6	17.50	24.3	4.8	26.2	5.0	2.77E-08	0.2
7	13.67	20.2	5.5	29.9	2.5	1.46E-08	0.2
8	13.25	23.6	5.0	26.8	7.5	4.19E-08	0.3
9	13.08	23.8	3.6	19.3	5.0	3.84E-08	0.3
10	11.25	22.2	2.8	15.0	2.5	2.66E-08	0.3
11	17.75	30.5	5.1	27.4	5.0	2.11E-08	0.3
12	17.17	23.4	5.0	26.8	6.0	3.38E-08	0.3
13	16.00	22.8	4.4	23.7	2.5	1.63E-08	0.3
14	11.92	19.9	4.7	25.6	2.5	1.74E-08	0.3
15	12.25	24.3	4.6	24.6	7.5	4.43E-08	0.4
16	13.50	25.3	3.7	20.0	6.0	4.21E-08	0.4
17	13.92	24.4	5.9	32.1	5.0	2.25E-08	0.4
18	13.67	23.8	7.2	38.7	9.0	3.47E-08	0.5
19	11.25	21.6	6.7	36.2	8.0	3.62E-08	0.5
20	14.50	27.3	6.6	35.9	8.5	3.08E-08	0.5
21	12.25	21.8	6.6	35.9	7.0	3.17E-08	0.5
22	13.75	25.5	5.5	29.6	22.0	1.03E-07	0.6
23	15.62	25.9	6.4	34.8	23.5	9.23E-08	0.7
25	15.50	47.9	6.5	35.2	41.5	8.70E-08	0.9
27	14.55	47.1	6.3	34.3	97.5	2.14E-07	1.2
28	11.17	20.6	6.3	34.0	44.0	2.22E-07	1.4
29	13.33	26.2	7.3	39.3	84.5	2.91E-07	1.7
30	11.25	21.9	7.2	38.7	75.0	3.13E-07	2.0
DEC 1	12.25	25.0	7.0	37.7	90.0	3.37E-07	2.3
6	13.33	24.7	7.1	38.3	41.0	1.53E-07	2.5
7	13.25	23.9	6.6	35.5	63.0	2.62E-07	2.7
8	13.50	24.3	6.6	35.9	54.0	2.20E-07	2.9
15	12.67	24.1	6.5	35.2	17.0	7.08E-08	3.0
16	8.40	19.7	6.3	34.3	14.0	7.32E-08	3.0
18	12.33	51.9	6.7	36.5	28.0	5.23E-08	3.2
19	13.50	25.2	6.3	34.3	16.0	6.55E-08	3.2
20	13.67	24.2	6.9	37.4	6.0	2.35E-08	3.2
21	13.25	23.6	5.4	29.3	20.0	1.02E-07	3.3
22	16.75	27.5	5.4	29.0	21.0	9.31E-08	3.4

(Continued)

Table D6 (Concluded)

Date	Time	Time Increment hrs	Head ft H_2O	Hydraulic Gradient i	Volume Leached cm^3	Permeability K cm/sec	# PV Leached
DEC 24	10.08	41.3	5.1	27.7	125.0	3.85E-07	3.9
26	10.33	48.3	5.4	29.0	125.0	3.16E-07	4.3
27	12.25	25.9	5.1	27.7	125.0	6.15E-07	4.8
JAN 5	15.67	22.3	5.2	28.1	100.0	5.66E-07	5.2
6	17.83	26.2	5.1	27.4	125.0	6.16E-07	5.6
MAR 29	14.92	28.9	4.3	23.4	262.0	1.37E-06	6.6
30	15.17	24.3	4.6	24.9	185.0	1.08E-06	7.3

Table D7

Ninth Avenue Permeameter Cell 7 Data

Date	Time	Time Increment hrs	Head ft H_2O	Hydraulic Gradient i	Volume Leached cm^3	Permeability K cm/sec	# PV Leached
OCT 28	14.25	0.0	2.4	12.8	0.0	Start-up	
29	14.92	24.7	2.9	15.6	7.0	6.44E-08	0.0
30	17.25	26.3	3.1	16.5	8.0	6.50E-08	0.1
31	13.42	20.2	3.0	16.2	2.5	2.70E-08	0.1
NOV 1	12.75	23.3	4.4	23.7	23.0	1.47E-07	0.2
2	13.17	24.4	4.7	25.3	16.0	9.17E-08	0.2
3	12.00	22.8	5.7	30.6	15.0	7.60E-08	0.3
4	12.67	24.7	5.4	29.0	16.0	7.91E-08	0.3
5	17.17	28.5	4.0	21.5	9.0	5.19E-08	0.4
6	17.50	24.3	4.4	24.0	5.0	3.03E-08	0.4
7	13.67	20.2	5.4	29.3	5.0	2.99E-08	0.4
8	13.25	23.6	5.4	29.3	41.0	2.10E-07	0.6
9	13.08	23.8	5.6	30.2	11.5	5.64E-08	0.6
10	11.25	22.2	5.8	31.5	10.0	5.07E-08	0.6
11	17.75	30.5	6.7	36.2	12.0	3.85E-08	0.7
12	17.17	23.4	6.9	37.4	15.0	6.05E-08	0.7
13	16.00	22.8	6.0	32.4	9.0	4.30E-08	0.8
14	11.92	19.9	5.6	30.2	6.5	3.82E-08	0.8
15	12.25	24.3	5.0	27.1	7.5	4.02E-08	0.8
16	13.50	25.3	5.4	29.3	11.0	5.26E-08	0.9
17	13.92	24.4	8.0	43.3	10.0	3.34E-08	0.9
18	13.67	23.8	7.8	42.4	20.0	7.02E-08	1.0
19	11.25	21.6	7.4	39.9	14.0	5.75E-08	1.0
20	14.50	27.3	5.8	31.5	12.0	4.95E-08	1.1
21	12.25	21.8	5.9	31.8	7.0	3.58E-08	1.1
22	13.75	25.5	6.4	34.6	9.0	3.61E-08	1.1
23	15.62	25.9	6.5	35.2	10.0	3.88E-08	1.2
25	15.50	47.9	6.5	35.2	21.0	4.40E-08	1.3
27	14.55	47.1	6.0	32.4	27.0	6.26E-08	1.4
28	11.17	20.6	5.6	30.2	9.0	5.10E-08	1.4
29	13.33	26.2	7.0	37.7	29.5	1.06E-07	1.5
30	11.25	21.9	7.0	38.0	19.0	8.06E-08	1.6
DEC 1	12.25	25.0	7.2	39.0	20.5	7.44E-08	1.6
2	12.75	24.5	7.1	38.3	18.5	6.96E-08	1.7
4	18.30	53.6	7.1	38.3	39.0	6.72E-08	1.9
5	12.67	18.4	7.1	38.3	13.0	6.53E-08	1.9
6	13.33	24.7	6.9	37.1	16.0	6.18E-08	2.0
7	13.25	23.9	6.9	37.1	16.0	6.38E-08	2.0
8	13.50	24.3	6.8	36.8	16.0	6.34E-08	2.1
9	13.25	23.8	6.8	36.8	15.0	6.07E-08	2.1
10	14.08	24.8	6.6	35.9	15.0	5.96E-08	2.2

(Continued)

(Sheet 1 of 3)

Table D7 (Continued)

Date	Time	Time Increment hrs	Head ft H_2O	Hydraulic Gradient i	Volume Leached cm^3	Permeability K cm/sec	# PV Leached
DEC 11	12.58	22.5	8.9	48.0	8.5	2.78E-08	2.2
12	8.25	19.7	8.1	43.6	45.0	1.85E-07	2.4
14	13.42	53.2	6.3	34.0	32.0	6.26E-08	2.5
15	12.67	23.3	5.4	29.3	10.0	5.19E-08	2.6
16	8.40	19.7	5.4	29.3	8.0	4.89E-08	2.6
18	12.33	51.9	5.7	30.9	20.0	4.41E-08	2.7
19	13.50	25.2	6.0	32.4	13.0	5.63E-08	2.7
20	13.67	24.2	7.2	39.0	10.0	3.75E-08	2.8
21	13.25	23.6	6.0	32.4	49.0	2.27E-07	2.9
22	16.75	27.5	5.4	29.3	24.0	1.05E-07	3.0
24	10.08	41.3	5.0	27.1	125.0	3.94E-07	3.5
26	10.33	48.3	5.1	27.7	125.0	3.30E-07	4.0
27	12.25	25.9	5.5	29.9	85.0	3.87E-07	4.3
28	10.83	22.6	5.7	30.6	58.0	2.97E-07	4.5
29	13.83	27.0	5.1	27.7	75.0	3.54E-07	4.8
30	17.17	27.3	5.1	27.7	52.0	2.42E-07	5.0
31	11.92	18.8	5.1	27.7	33.0	2.24E-07	5.1
JAN 1	19.00	31.1	5.1	27.7	54.0	2.21E-07	5.3
3	15.58	44.6	5.4	29.0	79.0	2.16E-07	5.6
4	17.42	25.8	5.8	31.5	72.0	3.13E-07	5.9
5	15.67	22.3	5.3	28.7	82.0	4.54E-07	6.2
6	17.83	26.2	5.2	28.1	64.0	3.08E-07	6.4
8	11.92	42.1	5.1	27.7	100.0	3.03E-07	6.8
9	15.00	27.1	5.4	29.3	53.0	2.36E-07	7.0
MAR 29	14.92	28.9	3.9	21.2	57.0	3.29E-07	7.2
30	15.17	24.3	3.5	19.0	12.0	9.20E-08	7.3
31	16.83	25.7	3.0	16.2	11.0	9.35E-08	7.3
APR 2	13.33	43.5	2.8	15.3	7.0	3.72E-08	7.3
3	16.92	27.6	2.8	15.0	10.0	8.56E-08	7.4
5	8.42	39.5	3.1	16.5	16.0	8.67E-08	7.4
6	15.5	31.1	3.2	17.2	12.5	8.26E-08	7.5
10	10.25	90.8	3.0	16.2	29.0	6.97E-08	7.6
11	8.17	21.9	3.1	16.5	4.0	3.91E-08	7.6
14	9.25	73.1	3.1	16.8	4.5	1.29E-08	7.6
15	13.33	28.1	3.1	16.8	9.0	6.73E-08	7.6
17	9.00	43.7	3.1	16.5	14.0	6.86E-08	7.7
18	14.33	29.3	3.2	17.1	12.0	8.44E-08	7.7
19	13.50	23.2	3.0	16.2	15.0	1.41E-07	7.8
20	14.00	24.5	3.5	18.7	17.0	1.31E-07	7.9
22	12.08	46.1	3.6	19.3	47.0	1.87E-07	8.0
24	10.00	45.9	3.2	17.5	52.0	2.29E-07	8.2

(Continued)

(Sheet 2 of 3)

Table D7 (Concluded)

Date	Time	Time Increment hrs	Head ft H_2O	Hydraulic Gradient i	Volume Leached cm^3	Permeability K cm/sec	# PV Leached
26	11.50	49.5	3.2	17.5	57.0	2.33E-07	8.4
28	8.83	45.3	3.5	18.7	65.0	2.71E-07	8.7
30	11.17	50.3	3.5	18.7	42.0	1.58E-07	8.8
MAY 1	13.37	26.2	3.5	18.7	19.0	1.37E-07	8.9
3	8.17	42.8	3.6	19.3	25.0	1.07E-07	9.0
4	14.20	30.0	3.7	20.0	19.5	1.15E-07	9.1
8	17.58	99.4	3.9	21.2	30.0	5.03E-08	9.2

(Sheet 3 of 3)

Table D8

Ninth Avenue Permeameter Cell 8 Data

Date	Time	Time Increment hrs	Head ft H_2O	Hydraulic Gradient i	Volume Leached cm^3	Permeability K cm/sec	# PV Leached
OCT 28	14.25	0.0	2.4	12.8	0.0	Start-up	
29	14.92	24.7	2.9	15.6	7.0	6.44E-08	0.0
30	17.25	26.3	3.1	16.5	8.0	6.50E-08	0.1
31	13.42	20.2	3.0	16.2	2.5	2.70E-08	0.1
NOV 1	12.75	23.3	4.4	23.7	23.0	1.47E-07	0.2
2	13.17	24.4	4.7	25.3	16.0	9.17E-08	0.2
3	12.00	22.8	5.7	30.6	15.0	7.60E-08	0.3
4	12.67	24.7	5.4	29.0	16.0	7.91E-08	0.3
5	17.17	28.5	4.0	21.5	9.0	5.19E-08	0.4
6	17.50	24.3	4.4	24.0	5.0	3.03E-08	0.4
7	13.67	20.2	5.4	29.3	5.0	2.99E-08	0.4
8	13.25	23.6	5.4	29.3	41.0	2.10E-07	0.6
9	13.08	23.8	5.6	30.2	11.5	5.64E-08	0.6
10	11.25	22.2	5.8	31.5	10.0	5.07E-08	0.6
11	17.75	30.5	6.7	36.2	12.0	3.85E-08	0.7
12	17.17	23.4	6.9	37.4	15.0	6.05E-08	0.7
13	16.00	22.8	6.0	32.4	9.0	4.30E-08	0.8
14	11.92	19.9	5.6	30.2	6.5	3.82E-08	0.8
15	12.25	24.3	5.0	27.1	7.5	4.02E-08	0.8
16	13.50	25.3	5.4	29.3	11.0	5.26E-08	0.9
17	13.92	24.4	8.0	43.3	10.0	3.34E-08	0.9
18	13.67	23.8	7.8	42.4	20.0	7.02E-08	1.0
19	11.25	21.6	7.4	39.9	14.0	5.75E-08	1.0
20	14.50	27.3	5.8	31.5	12.0	4.95E-08	1.1
21	12.25	21.8	5.9	31.8	7.0	3.58E-08	1.1
22	13.75	25.5	6.4	34.6	10.0	4.01E-08	1.1
23	15.62	25.9	6.5	35.2	11.0	4.27E-08	1.2
25	15.50	47.9	6.5	35.2	18.5	3.88E-08	1.2
27	14.55	47.1	6.0	32.4	10.5	2.43E-08	1.3
28	11.17	20.6	5.6	30.2	5.5	3.12E-08	1.3
29	13.33	26.2	7.0	37.7	9.0	3.22E-08	1.3
30	11.25	21.9	7.0	38.0	7.0	2.97E-08	1.4
DEC 1	12.25	25.0	7.2	39.0	8.0	2.90E-08	1.4
2	12.75	24.5	7.1	38.3	8.0	3.01E-08	1.4
4	18.30	53.6	7.1	38.3	17.5	3.01E-08	1.5
5	12.67	18.4	7.1	38.3	7.0	3.51E-08	1.5
6	13.33	24.7	6.9	37.1	7.0	2.71E-08	1.5
7	13.25	23.9	6.9	37.1	7.5	2.99E-08	1.6
8	13.50	24.3	6.8	36.8	8.0	3.17E-08	1.6
9	13.25	23.8	6.8	36.8	7.0	2.83E-08	1.6
10	14.08	24.8	6.6	35.9	8.0	3.18E-08	1.7

(Continued)

(Sheet 1 of 3)

Table D8 (Continued)

Date	Time	Time Increment hrs	Head ft H_2O	Hydraulic Gradient i	Volume Leached cm^3	Permeability K cm/sec	# PV Leached
11	12.58	22.5	8.9	48.0	5.0	1.64E-08	1.7
12	8.25	19.7	8.1	43.6	10.0	4.12E-08	1.7
14	13.42	53.2	6.3	34.0	17.0	3.33E-08	1.8
15	12.67	23.3	5.4	29.3	5.0	2.59E-08	1.8
16	8.40	19.7	5.4	29.3	4.5	2.75E-08	1.8
18	12.33	51.9	5.7	30.9	8.0	1.76E-08	1.8
19	13.50	25.2	6.0	32.4	5.0	2.17E-08	1.9
20	13.50	24.0	7.2	39.0	5.0	1.89E-08	1.9
21	13.25	23.8	6.0	32.4	7.0	3.21E-08	1.9
22	16.75	27.5	5.4	29.3	5.0	2.19E-08	1.9
24	10.08	41.3	5.0	27.1	7.0	2.21E-08	2.0
26	10.33	48.3	5.1	27.7	7.0	1.85E-08	2.0
27	12.25	25.9	5.5	29.9	5.0	2.28E-08	2.0
28	10.83	22.6	5.7	30.6	5.0	2.56E-08	2.0
29	13.83	27.0	5.1	27.7	6.0	2.83E-08	2.0
30	17.17	27.3	5.1	27.7	6.0	2.80E-08	2.1
31	11.92	18.8	5.1	27.7	5.0	3.40E-08	2.1
JAN 1	19.00	31.1	5.1	27.7	7.0	2.87E-08	2.1
3	15.58	44.6	5.4	29.0	11.0	3.01E-08	2.2
4	17.42	25.8	5.8	31.5	6.0	2.61E-08	2.2
5	15.67	22.3	5.3	28.7	5.0	2.77E-08	2.2
6	17.83	26.2	5.2	28.1	5.0	2.41E-08	2.2
8	11.92	42.1	5.1	27.7	7.0	2.12E-08	2.2
9	15.00	27.1	5.4	29.3	5.0	2.23E-08	2.3
10	15.58	24.6	5.9	31.8	5.0	2.26E-08	2.3
11	16.25	24.7	6.1	33.0	7.5	3.25E-08	2.3
13	16.58	48.3	6.2	33.7	15.0	3.26E-08	2.4
15	12.17	43.6	6.2	33.7	10.0	2.41E-08	2.4
17	14.58	50.4	6.2	33.7	11.0	2.29E-08	2.4
18	17.58	27.0	6.2	33.7	5.5	2.14E-08	2.5
19	16.25	22.7	6.2	33.7	5.0	2.32E-08	2.5
20	16.00	23.8	5.7	30.6	6.0	2.92E-08	2.5
22	11.67	43.7	6.9	37.4	24.0	5.19E-08	2.6
23	13.50	25.8	6.9	37.4	23.0	8.42E-08	2.7
24	15.92	26.4	6.6	35.5	23.5	8.85E-08	2.8
25	16.50	24.6	6.3	34.3	14.5	6.08E-08	2.8
26	16.25	23.8	5.9	31.8	13.0	6.09E-08	2.9
27	17.12	24.9	5.5	29.9	10.5	4.99E-08	2.9
29	11.58	42.5	5.5	29.9	16.0	4.45E-08	3.0
30	15.83	28.3	5.4	29.0	11.0	4.75E-08	3.0
31	15.50	23.7	5.3	28.7	8.0	4.17E-08	3.0

(Continued)

(Sheet 2 of 3)

Table D8 (Concluded)

Date	Time	Time Increment hrs	Head ft H_2O	Hydraulic Gradient i	Volume Leached cm^3	Permeability K cm/sec	# PV Leached
FEB 2	12.25	44.8	5.6	30.2	30.5	7.97E-08	3.2
3	17.42	29.2	5.5	29.6	44.0	1.80E-07	3.3
5	12.00	42.6	5.2	28.4	62.0	1.81E-07	3.6
8	9.30	69.3	4.8	26.2	264.0	5.14E-07	4.5
MAR 30	15.17	53.2	3.5	19.0	5.0	1.75E-08	4.6
APR 5	8.42	136.3	3.1	16.5	2.0	3.14E-09	4.6
26	11.50	507.1	3.2	17.5	3.0	1.20E-09	4.6
MAY 6	17.58	246.1	3.7	20.0	3.0	2.16E-09	4.6

(Sheet 3 of 3)

Table D9

Ninth Avenue Permeameter Cell 9 Data

Date	Time	Time Increment hrs	Head ft H_2O	Hydraulic Gradient i	Volume Leached cm^3	Permeability K cm/sec	# PV Leached
OCT 28	14.25	0.0	1.6	8.4	0.0	Start-up	
29	14.92	24.7	2.0	10.6	72.0	9.74E-07	0.3
30	17.25	26.3	1.8	10.0	56.0	7.54E-07	0.5
31	13.42	20.2	2.2	12.2	32.0	4.61E-07	0.6
NOV 1	12.75	23.3	1.2	6.5	68.0	1.57E-06	0.9
2	13.17	24.4	1.2	6.5	10.0	2.21E-07	1.0
3	12.00	22.8	2.1	11.2	33.0	4.55E-07	1.1
4	12.67	24.7	2.0	10.6	32.0	4.33E-07	1.2
5	17.17	28.5	2.0	10.6	20.0	2.34E-07	1.3
6	17.50	24.3	3.5	18.7	12.0	9.32E-08	1.3
7	13.67	20.2	2.3	12.5	9.0	1.27E-07	1.4
8	13.25	23.6	3.5	18.7	40.0	3.21E-07	1.5
9	13.08	23.8	3.5	18.7	19.0	1.51E-07	1.6
10	11.25	22.2	3.3	17.8	42.0	3.77E-07	1.8
11	17.75	30.5	4.0	21.5	40.0	2.16E-07	1.9
12	17.17	23.4	3.6	19.3	125.0	9.76E-07	2.4
13	16.00	22.8	4.0	21.8	126.0	8.94E-07	3.0
14	11.92	19.9	3.9	21.2	103.0	8.62E-07	3.4
15	12.25	24.3	3.7	20.0	164.0	1.19E-06	4.0
16	13.50	25.3	3.7	20.0	243.5	1.71E-06	5.0
17	13.92	24.4	5.0	27.1	90.0	4.80E-07	5.4
18	13.67	23.8	3.7	20.0	128.0	9.55E-07	5.9
19	11.25	21.6	3.2	17.5	170.0	1.60E-06	6.6
20	14.50	27.3	3.7	20.0	209.0	1.36E-06	7.4
21	12.25	21.8	3.7	20.0	73.0	5.95E-07	7.7
29	13.33	26.2	3.5	18.7	56.0	4.05E-07	7.9
30	11.25	21.9	3.5	18.7	50.0	4.31E-07	8.1
DEC 1	12.25	25.0	3.7	20.3	56.0	3.91E-07	8.3
2	12.75	24.5	3.6	19.3	51.5	3.85E-07	8.5
4	18.30	53.6	3.6	19.6	99.0	3.33E-07	8.9
5	12.67	18.4	3.3	18.1	30.0	3.19E-07	9.1
6	13.33	24.7	3.5	18.7	41.0	3.14E-07	9.2
7	13.25	23.9	3.5	18.7	32.0	2.53E-07	9.3
8	13.50	24.3	3.6	19.3	34.0	2.56E-07	9.5
10	14.08	48.6	4.0	21.8	33.0	1.10E-07	9.6
11	12.58	22.5	4.3	23.1	25.0	1.70E-07	9.7
12	8.25	19.7	3.6	19.6	60.0	5.49E-07	10.0
13	12.00	27.8	3.6	19.3	74.5	4.91E-07	10.3
15	12.67	23.4	3.4	18.4	33.0	2.71E-07	10.4
16	8.40	19.7	3.6	19.6	27.0	2.46E-07	10.5
18	12.33	51.9	3.7	20.0	50.0	1.71E-07	10.7
19	13.50	25.2	3.5	19.0	28.0	2.07E-07	10.8

(Continued)

(Sheet 1 of 3)

Table D9 (Continued)

Date	Time	Time Increment hrs	Head ft H_2O	Hydraulic Gradient i	Volume Leached cm^3	Permeability K cm/sec	# PV Leached
FEB 20	13.67	24.2	4.3	23.1	22.0	1.40E-07	10.9
21	13.25	23.6	3.2	17.5	34.0	2.92E-07	11.0
22	16.75	27.5	3.2	17.5	31.0	2.28E-07	11.2
24	10.08	41.3	4.1	22.1	40.0	1.55E-07	11.3
26	10.33	48.3	3.5	19.0	49.0	1.89E-07	11.5
27	12.25	25.9	3.3	18.1	26.0	1.96E-07	11.6
28	10.83	22.6	3.3	18.1	24.0	2.08E-07	11.7
29	13.83	27.0	3.5	18.7	26.0	1.82E-07	11.8
30	17.17	27.3	3.5	19.0	26.0	1.77E-07	11.9
31	11.92	18.8	3.2	17.1	16.0	1.76E-07	12.0
JAN 1	19.00	31.1	3.5	18.7	28.0	1.70E-07	12.1
3	15.58	44.6	3.5	18.7	49.0	2.08E-07	12.3
4	17.42	25.8	3.9	21.2	28.0	1.81E-07	12.4
5	15.67	22.3	3.5	18.7	24.0	2.04E-07	12.5
6	17.83	26.2	3.5	19.0	28.0	1.99E-07	12.6
8	11.42	41.6	3.3	18.1	50.0	2.35E-07	12.8
9	15.00	27.6	3.6	19.3	30.0	1.99E-07	12.9
10	15.58	24.6	3.2	17.5	26.0	2.14E-07	13.0
11	16.25	24.7	3.1	16.8	25.0	2.13E-07	13.1
13	16.58	48.3	3.3	17.8	49.0	2.02E-07	13.3
15	12.17	43.6	3.2	17.5	42.0	1.95E-07	13.5
17	14.58	50.4	3.5	19.0	48.0	1.77E-07	13.7
18	17.58	27.0	3.6	19.3	24.0	1.63E-07	13.8
19	16.25	22.7	3.3	18.1	20.5	1.77E-07	13.9
20	16.00	23.8	4.0	21.5	20.0	1.38E-07	14.0
22	11.67	43.7	3.6	19.6	44.0	1.81E-07	14.1
23	13.50	25.8	3.5	18.7	22.0	1.61E-07	14.2
24	15.92	26.4	3.5	19.0	23.0	1.62E-07	14.3
25	16.50	24.6	3.1	16.8	22.5	1.92E-07	14.4
26	16.25	23.8	3.5	19.0	22.0	1.72E-07	14.5
27	17.12	24.9	3.0	16.2	23.0	2.02E-07	14.6
29	11.58	42.5	3.3	17.8	38.0	1.78E-07	14.7
30	15.83	28.3	3.1	16.8	25.0	1.86E-07	14.8
31	15.50	23.7	3.5	18.7	21.5	1.72E-07	14.9
FEB 2	12.25	44.8	3.3	18.1	41.0	1.79E-07	15.1
10	17.17	29.9	3.2	17.5	36.0	2.44E-07	15.2
12	12.25	43.1	3.0	16.2	62.0	3.14E-07	15.5
13	10.42	22.2	3.0	16.2	28.0	2.75E-07	15.6
14	16.67	30.3	3.0	16.2	51.0	3.68E-07	15.8
16	9.17	40.5	3.2	17.1	76.0	3.87E-07	16.1
18	10.50	49.3	3.5	18.7	75.0	2.87E-07	16.4

(Continued)

(Sheet 2 of 3)

Table D9 (Concluded)

Date	Time	Time Increment hrs	Head ft H_2O	Hydraulic Gradient i	Volume Leached cm^3	Permeability K cm/sec	# PV Leached
FEB 20	10.08	47.6	3.0	16.2	64.0	2.93E-07	16.7
22	8.17	46.1	3.5	18.7	53.0	2.17E-07	16.9
23	8.17	24.0	3.2	17.1	29.5	2.53E-07	17.0
25	17.42	57.3	4.4	23.7	60.0	1.56E-07	17.2
27	9.08	39.7	3.3	18.1	41.0	2.02E-07	17.4
APR 20	14.00	23.5	3.6	19.3	20.0	1.56E-07	17.5
22	12.08	46.1	3.5	19.0	50.0	2.02E-07	17.7
24	10.00	45.9	3.5	18.7	83.0	3.42E-07	18.0
26	11.50	49.5	3.2	17.5	125.0	5.11E-07	18.5
28	8.42	44.9	3.3	17.8	125.0	5.54E-07	19.0
30	11.17	50.8	3.3	17.8	89.0	3.49E-07	19.4
MAY 1	13.37	26.2	3.5	18.7	33.0	2.38E-07	19.5
3	8.17	42.8	3.2	17.5	43.0	2.03E-07	19.7
4	14.20	30.0	3.5	18.7	28.0	1.76E-07	19.8
6	17.58	51.4	3.5	18.7	47.0	1.73E-07	20.0
8	16.50	46.9	3.6	19.6	42.0	1.61E-07	20.1

(Sheet 3 of 3)

Table D10

Ninth Avenue Permeameter Cell 10 Data

Date	Time	Time Increment hrs	Head ft H_2O	Hydraulic Gradient i	Volume Leached cm^3	Permeability K cm/sec	# PV Leached
OCT 28	14.25	0.0	1.6	8.4	0.0	Start-up	
29	14.92	24.7	2.0	10.6	13.0	1.76E-07	0.1
30	17.25	26.3	1.8	10.0	13.0	1.75E-07	0.1
31	13.42	20.2	2.2	12.2	10.0	1.44E-07	0.1
NOV 1	12.75	23.3	1.2	6.5	19.0	4.40E-07	0.2
2	13.17	24.4	1.2	6.5	6.0	1.33E-07	0.2
3	12.00	22.8	2.1	11.2	12.0	1.66E-07	0.3
4	12.67	24.7	2.0	10.6	15.0	2.03E-07	0.4
5	17.17	28.5	2.0	10.6	13.0	1.52E-07	0.4
6	17.50	24.3	3.5	18.7	10.0	7.77E-08	0.4
7	13.67	20.2	2.3	12.5	8.0	1.12E-07	0.5
8	13.25	23.6	3.5	18.7	51.5	4.13E-07	0.7
9	13.08	23.8	3.5	18.7	75.0	5.95E-07	1.0
10	11.25	22.2	3.3	17.8	70.0	6.28E-07	1.3
11	17.75	30.5	4.0	21.5	52.0	2.80E-07	1.5
12	17.17	23.4	3.6	19.3	22.0	1.72E-07	1.6
13	16.00	22.8	4.0	21.8	22.0	1.56E-07	1.6
14	11.92	19.9	3.9	21.2	18.0	1.51E-07	1.7
15	12.25	24.3	3.7	20.0	42.0	3.06E-07	1.9
16	13.50	25.3	3.7	20.0	127.0	8.91E-07	2.4
17	13.92	24.4	5.0	27.1	34.0	1.82E-07	2.5
18	13.67	23.8	3.7	20.0	22.5	1.68E-07	2.6
19	11.25	21.6	3.2	17.5	47.0	4.41E-07	2.8
20	14.50	27.3	3.7	20.0	54.0	3.51E-07	3.0
21	12.25	21.8	3.7	20.0	31.0	2.53E-07	3.2
22	13.75	25.5	3.5	19.0	30.0	2.19E-07	3.3
23	15.62	25.9	3.7	20.0	35.0	2.40E-07	3.4
25	15.50	47.9	3.9	20.9	61.5	2.17E-07	3.7
27	14.55	47.1	3.7	20.0	98.5	3.71E-07	4.1
29	13.33	46.8	3.5	18.7	35.0	1.41E-07	4.2
30	11.25	21.9	3.5	18.7	32.0	2.76E-07	4.3
DEC 1	12.25	25.0	3.7	20.3	36.5	2.55E-07	4.5
2	12.75	24.5	3.6	19.3	38.0	2.84E-07	4.6
4	18.30	53.6	3.6	19.6	74.0	2.49E-07	4.9
5	12.67	18.4	3.3	18.1	22.0	2.34E-07	5.0
6	13.33	24.7	3.5	18.7	22.5	1.72E-07	5.1
7	13.25	23.9	3.5	18.7	23.0	1.82E-07	5.2
8	13.50	24.3	3.6	19.3	16.0	1.21E-07	5.3
10	14.08	48.6	4.0	21.8	20.0	6.67E-08	5.3
11	12.58	22.5	4.3	23.1	15.0	1.02E-07	5.4
12	8.25	19.7	3.6	19.6	20.0	1.83E-07	5.5
14	13.42	53.2	3.5	18.7	39.5	1.40E-07	5.6

(Continued)

(Sheet 1 of 3)

Table D10 (Continued)

Date	Time	Time Increment hrs	Head ft H_2O	Hydraulic Gradient i	Volume Leached cm^3	Permeability K cm/sec	# PV Leached
DEC 15	12.67	23.3	3.4	18.4	16.0	1.32E-07	5.7
16	8.40	19.7	3.6	19.6	14.0	1.28E-07	5.8
18	12.33	51.9	3.7	20.0	29.0	9.90E-08	5.9
19	13.50	25.2	3.5	19.0	17.0	1.26E-07	5.9
20	13.67	24.2	4.3	23.1	14.0	8.88E-08	6.0
21	13.25	23.6	3.2	17.5	17.0	1.46E-07	6.1
22	16.75	27.5	3.2	17.5	17.0	1.25E-07	6.1
24	10.08	41.3	4.1	22.1	25.0	9.66E-08	6.2
26	10.33	48.3	3.5	19.0	23.0	8.86E-08	6.3
27	12.25	25.9	3.3	18.1	16.0	1.21E-07	6.4
28	10.83	22.6	3.3	18.1	13.0	1.13E-07	6.4
29	13.83	27.0	3.5	18.7	16.0	1.12E-07	6.5
30	17.17	27.3	3.5	19.0	16.0	1.09E-07	6.6
31	11.92	18.8	3.2	17.1	10.0	1.10E-07	6.6
JAN 1	19.00	31.1	3.5	18.7	18.0	1.09E-07	6.7
3	15.58	44.6	3.5	18.7	30.0	1.27E-07	6.8
4	17.42	25.8	3.9	21.2	17.0	1.10E-07	6.9
5	15.67	22.3	3.5	18.7	16.0	1.36E-07	6.9
6	17.83	26.2	3.5	19.0	17.0	1.21E-07	7.0
8	11.92	42.1	3.3	18.1	26.0	1.21E-07	7.1
9	15.00	27.1	3.6	19.3	18.0	1.22E-07	7.2
10	15.58	24.6	3.2	17.5	16.0	1.32E-07	7.2
11	16.25	24.7	3.1	16.8	15.0	1.28E-07	7.3
13	16.58	48.3	3.3	17.8	29.0	1.19E-07	7.4
15	12.17	43.6	3.2	17.5	26.0	1.21E-07	7.5
17	14.58	50.4	3.5	19.0	29.0	1.07E-07	7.6
18	17.58	27.0	3.6	19.3	10.5	7.11E-08	7.7
19	16.25	22.7	3.3	18.1	14.0	1.21E-07	7.7
20	16.00	23.8	4.0	21.5	13.5	9.34E-08	7.8
22	11.67	43.7	3.6	19.6	29.0	1.20E-07	7.9
23	13.50	25.8	3.5	18.7	15.0	1.10E-07	8.0
24	15.92	26.4	3.5	19.0	16.5	1.16E-07	8.0
25	16.50	24.6	3.1	16.8	16.0	1.37E-07	8.1
26	16.25	23.8	3.5	19.0	16.0	1.25E-07	8.2
27	17.12	24.9	3.0	16.2	16.0	1.40E-07	8.2
29	11.58	42.5	3.3	17.8	27.0	1.27E-07	8.3
30	15.83	28.3	3.1	16.8	18.0	1.34E-07	8.4
31	15.50	23.7	3.5	18.7	15.0	1.20E-07	8.5
FEB 2	12.25	44.8	3.3	18.1	28.0	1.22E-07	8.6
10	17.17	29.9	3.2	17.5	19.0	1.29E-07	8.7
12	12.25	43.1	3.0	16.2	26.0	1.32E-07	8.8
13	10.42	22.2	3.0	16.2	14.0	1.38E-07	8.8

(Continued)

(Sheet 2 of 3)

Table D10 (Concluded)

Date	Time	Time Increment hrs	Head ft H_2O	Hydraulic Gradient i	Volume Leached cm^3	Permeability K cm/sec	# PV Leached
FEB 14	16.67	30.3	3.0	16.2	19.0	1.37E-07	8.9
16	9.17	40.5	3.2	17.1	24.0	1.22E-07	9.0
18	10.50	49.3	3.5	18.7	32.0	1.23E-07	9.1
20	10.08	47.6	3.0	16.2	29.0	1.33E-07	9.2
22	8.17	46.1	3.5	18.7	27.0	1.11E-07	9.3
23	8.17	24.0	3.2	17.1	9.5	8.16E-08	9.4
25	17.42	57.3	4.4	23.7	37.0	9.64E-08	9.5
27	9.08	39.7	3.3	18.1	23.5	1.16E-07	9.6
MAR 1	8.17	47.1	3.0	16.2	26.0	1.20E-07	9.7
3	11.33	51.2	3.2	17.5	28.0	1.11E-07	9.8
5	13.92	50.6	3.0	16.2	27.0	1.16E-07	9.9
6	10.50	20.6	3.3	17.8	11.0	1.06E-07	10.0
8	16.75	54.3	3.3	17.6	29.0	1.07E-07	10.1
9	16.42	23.7	3.0	16.2	13.0	1.20E-07	10.2
12	16.00	71.6	3.2	17.5	37.0	1.05E-07	10.3
15	11.00	67.0	3.2	17.5	34.0	1.03E-07	10.4
APR 20	14.00	23.5	3.6	19.3	14.0	1.09E-07	10.5
22	12.08	46.1	3.5	19.0	38.0	1.53E-07	10.6
24	10.00	45.9	3.5	18.7	53.0	2.18E-07	10.9
26	11.50	49.5	3.2	17.5	62.0	2.54E-07	11.1
28	8.42	44.9	3.3	17.8	69.0	3.06E-07	11.4
30	11.17	50.8	3.3	17.8	54.0	2.12E-07	11.6
MAY 1	13.37	26.2	3.5	18.7	24.0	1.73E-07	11.7
3	8.17	42.8	3.2	17.5	34.0	1.61E-07	11.8
4	14.20	30.0	3.5	18.7	23.0	1.45E-07	11.9
6	17.58	51.4	3.5	18.7	37.0	1.36E-07	12.1
8	16.50	46.9	3.6	19.6	29.0	1.11E-07	12.2

(Sheet 3 of 3)

Table D11

Ninth Avenue Permeameter Cell 11 Data

Date	Time	Time Increment hrs	Head ft H_2O	Hydraulic Gradient i	Volume Leached cm^3	Permeability K cm/sec	# PV Leached
OCT 28	14.25	0.0	1.3	7.2	0.0	Start-up	
29	14.92	24.7	1.7	9.4	15.0	2.30E-07	0.1
30	17.25	26.3	1.3	6.9	14.0	2.74E-07	0.1
31	13.42	20.2	2.5	13.7	12.0	1.53E-07	0.2
NOV 1	12.75	23.3	3.3	17.8	54.0	4.61E-07	0.4
2	13.17	24.4	3.3	17.8	45.0	3.67E-07	0.6
3	12.00	22.8	2.9	15.6	30.0	2.98E-07	0.7
4	12.67	24.7	2.9	15.9	53.0	4.78E-07	0.9
5	17.17	28.5	3.0	16.2	40.0	3.06E-07	1.1
6	17.50	24.3	3.0	16.2	20.0	1.79E-07	1.1
7	13.67	20.2	4.6	24.9	15.0	1.05E-07	1.2
8	13.25	23.6	3.2	17.5	29.5	2.53E-07	1.3
9	13.08	23.8	3.5	18.7	30.0	2.38E-07	1.4
10	11.25	22.2	3.2	17.1	28.0	2.60E-07	1.5
11	17.75	30.5	3.6	19.3	31.0	1.86E-07	1.7
12	17.17	23.4	2.9	15.6	23.0	2.23E-07	1.8
13	16.00	22.8	3.3	18.1	20.0	1.71E-07	1.8
14	11.92	19.9	3.7	20.0	15.0	1.33E-07	1.9
16	13.50	49.6	3.5	18.7	22.5	8.58E-08	2.0
17	13.92	24.4	4.0	21.8	13.0	8.63E-08	2.0
18	13.67	23.8	3.2	17.5	17.0	1.45E-07	2.1
19	11.25	21.6	3.2	17.1	24.0	2.29E-07	2.2
20	14.50	27.3	3.2	17.5	28.0	2.08E-07	2.3
21	12.25	21.8	3.2	17.5	22.0	2.05E-07	2.4
22	13.75	25.5	3.3	17.8	25.0	1.95E-07	2.5
25	15.50	73.8	3.0	16.2	51.0	1.51E-07	2.7
27	14.55	47.1	3.2	17.1	50.0	2.19E-07	2.9
28	11.17	20.6	3.1	16.8	22.0	2.24E-07	3.0
29	13.33	26.2	3.3	18.1	30.0	2.24E-07	3.1
30	11.25	21.9	3.3	18.1	25.0	2.23E-07	3.2
DEC 1	12.25	25.0	3.2	17.5	28.0	2.27E-07	3.3
2	12.75	24.5	3.3	17.8	28.0	2.27E-07	3.4
4	18.30	53.6	3.5	18.7	59.0	2.08E-07	3.7
5	12.67	18.4	3.5	18.7	20.0	2.06E-07	3.8
6	13.33	24.7	3.2	17.5	22.0	1.81E-07	3.9
7	13.25	23.9	3.4	18.4	25.0	2.01E-07	4.0
8	13.50	24.3	3.2	17.5	24.0	2.00E-07	4.0
9	13.25	23.8	3.2	17.5	24.0	2.05E-07	4.1
10	14.08	24.8	3.7	20.3	24.0	1.69E-07	4.2
11	12.58	22.5	3.9	21.2	16.0	1.19E-07	4.3
12	8.25	19.7	3.2	17.1	19.0	1.99E-07	4.4
14	13.42	53.2	3.2	17.5	47.0	1.79E-07	4.6

(Continued)

(Sheet 1 of 3)

Table D11 (Continued)

Date	Time	Time Increment hrs	Head ft H_2O	Hydraulic Gradient i	Volume Leached cm^3	Permeability K cm/sec	# PV Leached
DEC 15	12.67	23.3	3.2	17.5	20.5	1.79E-07	4.7
16	8.40	19.7	3.2	17.5	17.0	1.75E-07	4.7
18	12.33	51.9	3.2	17.5	35.0	1.37E-07	4.9
19	13.50	25.2	3.1	16.8	20.0	1.67E-07	4.9
20	13.25	23.6	3.5	18.7	30.00	2.40E-07	5.1
21	13.67	24.2	3.5	18.7	19.00	1.49E-07	5.3
22	16.75	27.5	3.3	17.8	34.00	2.46E-07	5.1
24	10.08	41.3	4.4	24.0	50.00	1.78E-07	5.5
26	10.33	48.3	3.4	18.4	56.00	2.23E-07	5.7
27	12.25	25.9	3.4	18.4	31.00	2.30E-07	5.8
28	10.83	22.6	3.5	18.7	26.00	2.18E-07	5.9
29	13.83	27.0	3.5	18.7	31.00	2.17E-07	6.1
30	17.17	27.3	3.5	18.7	32.00	2.21E-07	6.2
31	11.92	18.8	3.3	18.1	20.00	2.09E-07	6.3
JAN 1	19.00	31.1	3.5	18.7	34.00	2.07E-07	6.4
3	15.58	44.6	3.3	17.8	47.00	2.10E-07	6.6
4	17.42	25.8	3.7	20.0	22.00	1.51E-07	6.7
5	15.67	22.3	3.3	17.8	23.00	2.06E-07	6.8
6	17.83	26.2	3.3	18.1	28.00	2.09E-07	6.9
8	11.92	42.1	3.5	18.7	44.00	1.98E-07	7.1
9	15.00	27.1	3.3	18.1	29.00	2.09E-07	7.2
10	15.58	24.6	3.3	18.1	26.00	2.07E-07	7.3
11	16.25	24.7	3.3	18.1	29.00	2.30E-07	7.4
13	16.58	48.3	3.5	18.7	56.00	2.19E-07	7.6
15	12.17	43.6	3.5	18.7	50.00	2.17E-07	7.8
17	14.58	50.4	3.5	18.7	57.00	2.14E-07	8.0
18	17.58	27.0	3.3	18.1	30.00	2.17E-07	8.2
19	16.25	22.7	3.3	18.1	25.00	2.16E-07	8.3
20	16.00	23.8	3.8	20.6	22.00	1.59E-07	8.4
22	11.67	43.7	3.3	18.1	42.00	1.88E-07	8.5
23	13.50	25.8	3.2	17.5	25.00	1.96E-07	8.6
24	15.92	26.4	3.2	17.5	25.50	1.95E-07	8.7
25	16.50	24.6	3.3	17.8	23.00	1.86E-07	8.8
26	16.25	23.8	3.2	17.5	23.00	1.96E-07	8.9
27	17.12	24.9	3.2	17.5	23.00	1.87E-07	9.0
FEB 10	17.17	29.9	3.3	18.1	33.00	2.16E-07	9.1
12	12.25	43.1	3.2	17.5	53.00	2.49E-07	9.3
13	10.42	22.2	3.3	17.8	28.00	2.51E-07	9.5
14	16.67	30.3	3.3	17.8	37.00	2.43E-07	9.6
16	9.17	40.5	3.4	18.4	50.00	2.37E-07	9.8
18	10.50	49.3	3.3	18.1	56.00	2.22E-07	10.0
20	10.08	47.6	3.3	17.8	54.00	2.26E-07	10.2
22	8.17	46.1	3.5	19.0	55.00	2.22E-07	10.5

(Continued)

(Sheet 2 of 3)

Table D11 (Concluded)

Date	Time	Time Increment hrs	Head ft H_2O	Hydraulic Gradient i	Volume Leached cm^3	Permeability K cm/sec	# PV Leached
FEB 12	12.25	43.1	3.2	17.5	53.00	2.49E-07	9.3
13	10.42	22.2	3.3	17.8	28.00	2.51E-07	9.5
14	16.67	30.3	3.3	17.8	37.00	2.43E-07	9.6
16	9.17	40.5	3.4	18.4	50.00	2.37E-07	9.8
18	10.50	49.3	3.3	18.1	56.00	2.22E-07	10.0
20	10.08	47.6	3.3	17.8	54.00	2.26E-07	10.2
22	8.17	46.1	3.5	19.0	55.00	2.22E-07	10.5
23	8.17	24.0	3.6	19.3	29.00	2.21E-07	10.6
25	17.42	57.3	3.4	18.4	67.00	2.25E-07	10.9
27	9.08	39.7	3.5	18.7	48.00	2.29E-07	11.0
APR 20	14.00	23.5	3.6	19.6	29.00	2.22E-07	11.2
22	12.08	46.1	3.5	19.0	74.00	2.99E-07	11.5
24	10.00	45.9	3.5	18.7	125.00	5.15E-07	12.0
26	11.50	49.5	3.5	18.7	125.00	4.77E-07	12.5
28	8.42	44.9	3.5	18.7	125.00	5.25E-07	13.0
30	11.17	50.8	3.5	18.7	125.00	4.66E-07	13.5
MAY 1	13.37	26.2	3.5	18.7	68.00	4.91E-07	13.7
3	8.17	42.8	3.5	19.0	105.00	4.56E-07	14.2
4	14.20	30.0	3.5	18.7	62.00	3.90E-07	14.4
6	17.58	51.4	3.5	18.7	110.00	4.05E-07	14.8
8	16.50	46.9	3.4	18.4	93.00	3.81E-07	15.2

(Sheet 3 of 3)

Table D12

Ninth Avenue Permeameter Cell 12 Data

Date	Time	Time Increment hrs	Head ft H_2O	Hydraulic Gradient i	Volume Leached cm^3	Permeability K cm/sec	# PV Leached
OCT 28	14.25	0.0	1.3	7.2	0.0	Start-up	
29	14.92	24.7	1.7	9.4	13.0	1.99E-07	0.1
30	17.25	26.3	1.3	6.9	14.0	2.74E-07	0.1
31	13.42	20.2	2.5	13.7	12.0	1.53E-07	0.2
NOV 1	12.75	23.3	3.3	17.8	65.0	5.54E-07	0.4
2	13.17	24.4	3.3	17.8	48.0	3.91E-07	0.6
3	12.00	22.8	2.9	15.6	40.0	3.97E-07	0.8
4	12.67	24.7	2.9	15.9	41.0	3.70E-07	0.9
5	17.17	28.5	3.0	16.2	34.0	2.60E-07	1.1
6	17.50	24.3	3.0	16.2	22.0	1.97E-07	1.2
7	13.67	20.2	4.6	24.9	15.0	1.05E-07	1.2
8	13.25	23.6	3.2	17.5	54.5	4.68E-07	1.4
9	13.08	23.8	3.5	18.7	36.0	2.86E-07	1.6
10	11.25	22.2	3.2	17.1	28.0	2.60E-07	1.7
11	17.75	30.5	3.6	19.3	28.0	1.68E-07	1.8
12	17.17	23.4	2.9	15.6	21.0	2.03E-07	1.9
13	16.00	22.8	3.3	18.1	11.0	9.42E-08	1.9
14	11.92	19.9	3.7	20.0	15.0	1.33E-07	2.0
16	13.50	49.6	3.5	18.7	23.0	8.77E-08	2.1
17	13.92	24.4	4.0	21.8	15.0	9.95E-08	2.1
18	13.67	23.8	3.2	17.5	15.5	1.32E-07	2.2
19	11.25	21.6	3.2	17.1	16.0	1.53E-07	2.3
20	14.50	27.3	3.2	17.5	23.0	1.71E-07	2.4
21	12.25	21.8	3.2	17.5	17.0	1.58E-07	2.4
22	13.75	25.5	3.3	17.8	18.0	1.40E-07	2.5
23	15.62	25.9	3.2	17.5	20.0	1.57E-07	2.6
25	15.50	47.9	3.0	16.2	35.0	1.59E-07	2.7
27	14.55	47.1	3.2	17.1	35.5	1.56E-07	2.9
28	11.17	20.6	3.1	16.8	16.0	1.63E-07	2.9
29	13.33	26.2	3.3	18.1	22.0	1.64E-07	3.0
30	11.25	21.9	3.3	18.1	18.0	1.61E-07	3.1
DEC 1	12.25	25.0	3.2	17.5	20.0	1.62E-07	3.2
2	12.75	24.5	3.3	17.8	19.5	1.58E-07	3.3
4	18.30	53.6	3.5	18.7	42.0	1.48E-07	3.4
5	12.67	18.4	3.5	18.7	14.5	1.49E-07	3.5
6	13.33	24.7	3.2	17.5	18.0	1.48E-07	3.5
7	13.25	23.9	3.4	18.4	18.5	1.49E-07	3.6
8	13.50	24.3	3.2	17.5	18.0	1.50E-07	3.7
9	13.25	23.8	3.2	17.5	18.0	1.53E-07	3.8
10	14.08	24.8	3.7	20.3	19.0	1.34E-07	3.8
11	12.58	22.5	3.9	21.2	15.0	1.11E-07	3.9
12	8.25	19.7	3.2	17.1	16.0	1.68E-07	4.0

(Continued)

(Sheet 1 of 3)

Table D12 (Continued)

Date	Time	Time Increment hrs	Head ft H_2O	Hydraulic Gradient i	Volume Leached cm^3	Permeability K cm/sec	# PV Leached
DEC 14	13.42	53.2	3.2	17.5	37.0	1.41E-07	4.1
15	12.67	23.3	3.2	17.5	16.0	1.39E-07	4.2
16	8.40	19.7	3.2	17.5	14.0	1.44E-07	4.2
18	12.33	51.9	3.2	17.5	30.0	1.17E-07	4.4
19	13.50	25.2	3.1	16.8	17.0	1.42E-07	4.4
20	13.67	24.2	3.5	18.7	16.0	1.25E-07	4.5
21	13.25	23.6	3.5	18.7	20.0	1.60E-07	4.6
22	16.75	27.5	3.3	17.8	22.0	1.59E-07	4.7
24	10.08	41.3	4.4	24.0	33.0	1.18E-07	4.8
26	10.33	48.3	3.4	18.4	34.0	1.35E-07	4.9
27	12.25	25.9	3.4	18.4	21.0	1.56E-07	5.0
28	10.83	22.6	3.5	18.7	17.0	1.42E-07	5.1
29	13.83	27.0	3.5	18.7	20.0	1.40E-07	5.2
30	17.17	27.3	3.5	18.7	21.0	1.45E-07	5.2
31	11.92	18.8	3.3	18.1	13.5	1.41E-07	5.3
JAN 1	19.00	31.1	3.5	18.7	23.0	1.40E-07	5.4
3	15.58	44.6	3.3	17.8	32.0	1.43E-07	5.5
4	17.42	25.8	3.7	20.0	18.0	1.23E-07	5.6
5	15.67	22.3	3.3	17.8	11.0	9.84E-08	5.6
6	17.83	26.2	3.3	18.1	19.0	1.42E-07	5.7
8	11.92	42.1	3.5	18.7	29.5	1.32E-07	5.8
9	15.00	27.1	3.3	18.1	20.0	1.44E-07	5.9
10	15.58	24.6	3.3	18.1	18.0	1.43E-07	6.0
11	16.25	24.7	3.3	18.1	19.0	1.51E-07	6.1
13	16.58	48.3	3.5	18.7	37.0	1.45E-07	6.2
15	12.17	43.6	3.5	18.7	34.0	1.47E-07	6.3
17	14.58	50.4	3.5	18.7	34.0	1.27E-07	6.5
18	17.58	27.0	3.3	18.1	20.0	1.45E-07	6.6
19	16.25	22.7	3.3	18.1	17.0	1.47E-07	6.6
20	16.00	23.8	3.8	20.6	17.0	1.23E-07	6.7
22	11.67	43.7	3.3	18.1	31.0	1.39E-07	6.8
23	13.50	25.8	3.2	17.5	18.0	1.41E-07	6.9
24	15.92	26.4	3.2	17.5	18.0	1.38E-07	7.0
25	16.50	24.6	3.3	17.8	17.0	1.38E-07	7.0
26	16.25	23.8	3.2	17.5	17.0	1.45E-07	7.1
27	17.12	24.9	3.2	17.5	17.0	1.38E-07	7.2
FEB 10	17.17	29.9	3.3	18.1	24.0	1.57E-07	7.3
12	12.25	43.1	3.2	17.5	35.0	1.65E-07	7.4
13	10.42	22.2	3.3	17.8	18.0	1.62E-07	7.5
14	16.67	30.3	3.3	17.8	25.0	1.64E-07	7.6
16	9.17	40.5	3.4	18.4	32.0	1.52E-07	7.7
18	10.5	49.3	3.3	18.1	36.0	1.43E-07	7.8

(Continued)

(Sheet 2 of 3)

Table D12 (Concluded)

Date	Time	Time Increment hrs	Head ft H_2O	Hydraulic Gradient i	Volume Leached cm^3	Permeability K cm/sec	# PV Leached
FEB 20	10.08	47.6	3.3	17.8	34.0	1.42E-07	8.0
22	8.17	46.1	3.5	19.0	35.0	1.41E-07	8.1
23	8.17	24.0	3.6	19.3	19.0	1.45E-07	8.2
25	17.42	57.3	3.4	18.4	44.0	1.48E-07	8.4
27	9.08	39.7	3.5	18.7	31.0	1.48E-07	8.5
APR 20	14.00	23.5	3.6	19.6	19.5	1.49E-07	8.6
22	12.08	46.1	3.5	19.0	42.0	1.69E-07	8.7
24	10.00	45.9	3.5	18.7	52.0	2.14E-07	9.0
26	11.50	49.5	3.5	18.7	67.0	2.56E-07	9.2
28	8.42	44.9	3.5	18.7	62.0	2.61E-07	9.5
30	11.17	50.8	3.5	18.7	65.0	2.42E-07	9.7
MAY 1	13.37	26.2	3.5	18.7	32.0	2.31E-07	9.9
3	8.17	42.8	3.5	19.0	43.0	1.87E-07	10.0
4	14.20	30.0	3.5	18.7	30.0	1.89E-07	10.2
6	17.58	51.4	3.5	18.7	51.0	1.88E-07	10.4
8	16.50	46.9	3.4	18.4	40.0	1.64E-07	10.6

(Sheet 3 of 3)

Table D13

Ninth Avenue Permeameter Cell 13 Data

Date	Time	Time Increment hrs	Head ft H_2O	Hydraulic Gradient i	Volume Leached cm^3	Permeability K cm/sec	# PV Leached
OCT 28	14.25	0.0	0.8	4.4	0.0	Start-up	
29	14.92	24.7	0.7	3.7	17.0	6.51E-07	0.1
30	17.25	26.3	0.7	3.7	22.0	7.90E-07	0.2
31	13.42	20.2	2.1	11.2	22.0	3.44E-07	0.2
NOV 1	12.75	23.3	3.4	18.4	111.0	9.15E-07	0.7
2	13.17	24.4	3.5	18.7	79.0	6.12E-07	1.0
3	12.00	22.8	2.6	14.0	108.0	1.19E-06	1.4
4	12.67	24.7	2.8	15.0	56.0	5.36E-07	1.7
5	17.17	28.5	2.9	15.6	21.0	1.67E-07	1.7
6	17.50	24.3	3.9	21.2	23.0	1.58E-07	1.8
7	15.75	22.3	4.4	24.0	56.0	3.71E-07	2.1
8	13.25	21.5	2.2	11.8	102.0	1.42E-06	2.5
9	13.08	23.8	2.5	13.7	28.0	3.03E-07	2.6
10	11.25	22.2	2.3	12.5	32.5	4.16E-07	2.7
11	17.75	30.5	3.8	20.6	15.0	8.45E-08	2.8
12	17.17	23.4	3.8	20.6	59.0	4.33E-07	3.0
13	16.00	22.8	3.2	17.5	29.0	2.57E-07	3.1
14	11.92	19.9	3.7	20.0	18.0	1.60E-07	3.2
16	13.50	49.6	1.8	10.0	45.0	3.22E-07	3.4
17	13.92	24.4	4.8	26.2	13.0	7.19E-08	3.4
18	13.67	23.8	3.5	18.7	40.0	3.18E-07	3.6
19	11.25	21.6	2.8	15.3	22.0	2.36E-07	3.7
20	14.50	27.3	2.1	11.2	11.5	1.33E-07	3.7
21	12.25	21.8	2.4	13.1	5.0	6.21E-08	3.7
22	13.75	25.5	2.8	15.0	7.0	6.49E-08	3.8
23	15.62	25.9	3.0	16.2	8.5	7.17E-08	3.8
25	15.50	47.9	3.2	17.1	17.5	7.54E-08	3.9
27	14.55	47.1	2.6	14.0	15.5	8.30E-08	3.9
28	11.17	20.6	2.4	13.1	5.0	6.55E-08	4.0
29	13.33	26.2	4.2	22.8	16.0	9.50E-08	4.0
30	11.25	21.9	3.8	20.6	12.0	9.41E-09	4.1
DEC 1	12.25	25.0	3.8	20.6	12.0	8.25E-08	4.1
2	12.75	24.5	4.0	21.8	12.0	7.94E-08	4.2
4	18.30	53.6	3.7	20.3	26.0	8.47E-08	4.3
5	12.67	18.4	3.8	20.6	9.0	8.42E-08	4.3
6	13.33	24.7	3.7	20.0	11.0	7.90E-08	4.4
7	13.25	23.9	4.0	21.8	12.0	8.13E-08	4.4
8	13.50	24.3	3.9	21.2	12.0	8.25E-08	4.5
9	13.25	23.8	3.9	20.9	10.0	7.13E-08	4.5
10	14.08	24.8	3.3	18.1	10.0	7.88E-08	4.5
11	12.58	22.5	4.0	21.8	5.0	3.60E-08	4.6

(Continued)

(Sheet 1 of 3)

Table D13 (Continued)

Date	Time	Time Increment hrs	Head ft H_2O	Hydraulic Gradient i	Volume Leached cm^3	Permeability K cm/sec	# PV Leached
DEC 12	8.25	19.7	4.6	24.9	34.0	2.45E-07	4.7
14	13.42	53.2	3.0	16.2	30.0	1.23E-07	4.8
15	12.67	23.3	2.3	12.5	9.0	1.10E-07	4.8
16	8.40	19.7	2.0	10.9	6.0	9.85E-08	4.9
18	12.33	51.9	3.5	18.7	23.0	8.37E-08	5.0
19	13.50	25.2	3.7	20.0	15.0	1.06E-07	5.0
20	13.67	24.2	4.7	25.3	13.0	7.53E-08	5.1
21	13.25	23.6	4.0	21.8	19.0	1.31E-07	5.1
22	16.75	27.5	3.3	18.1	16.0	1.14E-07	5.2
24	10.08	41.3	3.2	17.1	22.0	1.10E-07	5.3
26	10.33	48.3	3.3	18.1	23.0	9.32E-08	5.4
27	12.25	25.9	3.5	19.0	16.0	1.15E-07	5.5
28	10.83	22.6	2.8	15.0	18.0	1.88E-07	5.5
29	13.83	27.0	3.0	16.2	12.0	9.69E-08	5.6
30	17.17	27.3	2.9	15.6	27.0	2.24E-07	5.7
31	11.92	18.8	2.8	15.0	13.0	1.64E-07	5.7
JAN 1	19.00	31.1	2.5	13.7	22.0	1.82E-07	5.8
3	15.58	44.6	3.1	16.8	27.0	1.27E-07	5.9
4	17.42	25.8	2.3	12.5	8.0	8.78E-08	6.0
5	15.67	22.3	3.6	19.6	8.0	6.47E-08	6.0
6	17.83	26.2	3.4	18.4	27.0	1.98E-07	6.1
8	11.92	42.1	3.7	20.0	22.5	9.47E-08	6.2
9	15.00	27.1	2.9	15.6	10.0	8.38E-08	6.2
10	15.58	24.6	3.0	16.2	14.0	1.24E-07	6.3
11	16.25	24.7	3.1	16.5	14.0	1.21E-07	6.3
13	16.58	48.3	2.8	15.0	28.0	1.37E-07	6.5
15	12.17	43.6	2.9	15.6	23.0	1.20E-07	6.6
17	14.58	50.4	2.8	15.3	20.0	9.18E-08	6.6
18	17.58	27.0	2.8	15.3	12.0	1.03E-07	6.7
19	16.25	22.7	2.8	15.3	12.0	1.23E-07	6.7
20	16.00	23.8	3.1	16.8	10.0	8.84E-08	6.8
22	11.67	43.7	3.2	17.5	39.0	1.81E-07	6.9
24	15.92	52.3	4.0	21.8	32.0	9.92E-08	7.1
25	16.50	24.6	3.7	20.0	57.0	4.11E-07	7.3
26	16.25	23.8	3.7	20.0	82.0	6.12E-07	7.6
27	17.12	24.9	4.4	23.7	125.0	7.50E-07	8.1
FEB 10	17.17	29.9	3.0	16.2	36.0	2.62E-07	8.3
12	12.25	43.1	3.1	6.8	29.0	1.41E-07	8.4
13	10.42	22.2	3.2	17.5	15.0	1.37E-07	8.4
14	16.67	30.3	3.3	18.1	32.0	2.07E-07	8.6
16	9.17	40.5	3.0	16.2	36.0	1.94E-07	8.7
20	10.08	47.6	3.5	18.7	55.5	2.20E-07	8.9

(Continued)

(Sheet 2 of 3)

Table D13 (Concluded)

Date	Time	Time Increment hrs	Head ft H_2O	Hydraulic Gradient i	Volume Leached cm^3	Permeability K cm/sec	# PV Leached
FEB 22	8.17	46.1	3.0	16.2	38.0	1.80E-07	9.1
23	8.17	24.0	3.5	19.0	23.0	1.78E-07	9.2
25	17.42	57.3	4.0	21.8	97.0	2.75E-07	9.6
27	9.08	39.7	3.7	20.3	51.0	2.24E-07	9.8
APR 5	8.42	39.0	1.2	6.2	15.0	2.18E-07	9.8
6	15.50	30.4	3.1	16.8	2.0	1.38E-08	9.8
10	10.25	90.8	1.8	9.7	58.0	2.32E-07	10.0
11	8.17	21.9	2.4	12.8	15.0	1.89E-07	10.1
14	9.25	73.1	2.5	13.7	20.5	7.23E-08	10.1
15	13.33	28.1	2.8	15.0	13.0	1.09E-07	10.2
17	9.00	43.7	2.5	13.7	19.5	1.15E-07	10.3
18	14.33	29.3	3.1	16.5	14.0	1.02E-07	10.3
19	13.50	23.2	2.4	13.1	14.0	1.63E-07	10.4
20	14.00	23.5	3.5	18.7	12.5	1.01E-07	10.4
22	12.08	46.1	3.0	16.2	30.0	1.42E-07	10.6
24	10.00	45.9	3.1	16.8	23.0	1.05E-07	10.7
26	11.50	49.5	3.1	16.5	23.0	9.94E-08	10.7
28	8.42	44.9	2.8	15.3	25.0	1.29E-07	10.8
30	11.17	50.8	2.7	14.3	20.0	9.72E-08	10.9
MAY 1	13.37	26.2	2.9	15.6	10.0	8.66E-08	11.0
3	8.17	42.8	3.0	16.2	15.0	7.64E-08	11.0
4	14.20	30.0	3.2	17.5	13.0	8.77E-08	11.1
6	17.58	51.4	3.2	17.5	22.0	8.67E-08	11.2
8	16.50	46.9	2.9	15.6	21.0	1.02E-07	11.3

(Sheet 3 of 3)

Table D14

Ninth Avenue Permeameter Cell 14 Data

Date	Time	Time Increment hrs	Head ft H_2O	Hydraulic Gradient i	Volume Leached cm^3	Permeability K cm/sec	# PV Leached
OCT 28	14.25	0.0	0.8	4.4	0.0	Start-up	
29	14.92	24.7	0.7	3.7	2.5	9.58E-08	0.0
30	17.25	26.3	0.7	3.7	12.0	4.31E-07	0.1
31	13.42	20.2	2.1	11.2	7.0	1.09E-07	0.1
NOV 1	12.75	23.3	3.4	18.4	31.0	2.55E-07	0.2
2	13.17	24.4	3.5	18.7	50.0	3.87E-07	0.4
3	12.00	22.8	2.6	14.0	50.0	5.52E-07	0.6
4	12.67	24.7	2.8	15.0	70.0	6.70E-07	0.9
5	17.17	28.5	2.9	15.6	50.0	3.98E-07	1.1
6	17.50	24.3	3.9	21.2	25.0	1.71E-07	1.2
7	15.75	22.3	4.4	24.0	23.0	1.52E-07	1.3
8	13.25	21.5	2.2	11.8	34.5	4.79E-07	1.4
9	13.08	23.8	2.5	13.7	20.0	2.16E-07	1.5
10	11.25	22.2	2.3	12.5	20.5	2.62E-07	1.6
11	17.75	30.5	3.8	20.6	19.0	1.07E-07	1.7
12	17.17	23.4	3.8	20.6	30.0	2.20E-07	1.8
13	16.00	22.8	3.2	17.5	17.0	1.51E-07	1.8
14	11.92	19.9	3.7	20.0	15.0	1.33E-07	1.9
16	13.50	49.6	1.8	10.0	47.0	3.36E-07	2.1
17	13.92	24.4	4.8	26.2	19.5	1.08E-07	2.2
18	13.67	23.8	3.5	18.7	26.0	2.07E-07	2.3
19	11.25	21.6	2.8	15.3	22.0	2.36E-07	2.4
20	14.50	27.3	2.1	11.2	21.0	2.43E-07	2.5
21	12.25	21.8	2.4	13.1	13.0	1.61E-07	2.5
22	13.75	25.5	2.8	15.0	17.0	1.58E-07	2.6
23	15.62	25.9	3.0	16.2	20.0	1.69E-07	2.7
25	15.50	47.9	3.2	17.1	36.0	1.55E-07	2.8
27	14.55	47.1	2.6	14.0	38.0	2.04E-07	3.0
28	11.17	20.6	2.4	13.1	11.0	1.44E-07	3.0
29	13.33	26.2	4.2	22.8	31.0	1.84E-07	3.1
30	11.25	21.9	3.8	20.6	26.0	2.04E-07	3.2
DEC 1	12.25	25.0	3.8	20.6	22.0	1.51E-07	3.3
2	12.75	24.5	4.0	21.8	26.0	1.72E-07	3.4
4	18.30	53.6	3.7	20.3	56.0	1.82E-07	3.6
5	12.67	18.4	3.8	20.6	17.5	1.64E-07	3.7
6	13.33	24.7	3.7	20.0	23.0	1.65E-07	3.8
7	13.25	23.9	4.0	21.8	18.0	1.22E-07	3.9
8	13.50	24.3	3.9	21.2	23.0	1.58E-07	4.0
9	13.25	23.8	3.9	20.9	22.0	1.57E-07	4.1
10	14.08	24.8	3.3	18.1	22.0	1.73E-07	4.1
11	12.58	22.5	4.0	21.8	13.0	9.36E-08	4.2
12	8.25	19.7	4.6	24.9	45.0	3.24E-07	4.4

(Continued)

(Sheet 1 of 3)

Table D14 (Continued)

Date	Time	Time Increment hrs	Head ft H_2O	Hydraulic Gradient i	Volume Leached cm^3	Permeability K cm/sec	# PV Leached
DEC 14	13.42	53.2	3.0	16.2	48.0	1.97E-07	4.6
15	12.67	23.3	2.3	12.5	14.5	1.77E-07	4.6
16	8.40	19.7	2.0	10.9	10.0	1.64E-07	4.7
18	12.33	51.9	3.5	18.7	32.0	1.16E-07	4.8
19	13.50	25.2	3.7	20.0	21.0	1.48E-07	4.9
20	13.67	24.2	4.7	25.3	19.0	1.10E-07	5.0
21	13.25	23.6	4.0	21.8	32.0	2.20E-07	5.1
22	16.75	27.5	3.3	18.1	22.0	1.56E-07	5.2
24	10.08	41.3	3.2	17.1	35.0	1.75E-07	5.3
26	10.33	48.3	3.3	18.1	35.0	1.42E-07	5.5
27	12.25	25.9	3.5	19.0	22.0	1.58E-07	5.5
28	10.83	22.6	2.8	15.0	27.0	2.83E-07	5.6
29	13.83	27.0	3.0	16.2	20.0	1.62E-07	5.7
30	17.17	27.3	2.9	15.6	21.0	1.74E-07	5.8
31	11.92	18.8	2.8	15.0	12.0	1.51E-07	5.9
JAN 1	19.00	31.1	2.5	13.7	19.0	1.58E-07	5.9
3	15.58	44.6	3.1	16.8	31.0	1.46E-07	6.1
4	17.42	25.8	2.3	12.5	16.0	1.76E-07	6.1
5	15.67	22.3	3.6	19.6	19.0	1.54E-07	6.2
6	17.83	26.2	3.4	18.4	26.5	1.95E-07	6.3
8	11.92	42.1	3.7	20.0	40.0	1.68E-07	6.5
9	15.00	27.1	2.9	15.6	18.5	1.55E-07	6.5
10	15.58	24.6	3.0	16.2	18.0	1.60E-07	6.6
11	16.25	24.7	3.1	16.5	18.0	1.56E-07	6.7
13	16.58	48.3	2.8	15.0	35.0	1.71E-07	6.8
15	12.17	43.6	2.9	15.6	34.0	1.77E-07	7.0
18	17.58	77.4	2.8	15.3	24.0	7.18E-08	7.1
19	16.25	22.7	2.8	15.3	18.5	1.89E-07	7.1
20	16.00	23.8	3.1	16.8	14.0	1.24E-07	7.2
22	11.67	43.7	3.2	17.5	80.0	3.71E-07	7.5
24	15.92	52.3	4.0	21.8	67.0	2.08E-07	7.8
25	16.50	24.6	3.7	20.0	56.0	4.04E-07	8.0
26	16.25	23.8	[illegible]7	20.0	38.0	2.84E-07	8.2
27	17.12	24.9	4.4	23.7	29.0	1.74E-07	8.3
FEB 10	17.17	29.9	3.0	16.2	125.0	9.11E-07	8.8
12	12.25	43.1	3.1	16.8	154.0	7.51E-07	9.4
13	10.42	22.2	3.2	17.5	68.0	6.21E-07	9.7
14	16.67	30.3	3.3	18.1	91.0	5.88E-07	10.0
16	9.17	40.5	3.0	16.2	100.0	5.39E-07	10.4
20	10.08	47.6	3.5	18.7	125.0	4.97E-07	10.9
22	8.17	46.1	3.0	16.2	99.0	4.68E-07	11.3
APR 5	8.42	39.0	1.2	6.2	5.0	7.27E-08	11.3

(Continued)

(Sheet 2 of 3)

Table D14 (Continued)

Date	Time	Time Increment hrs	Head ft H_2O	Hydraulic Gradient i	Volume Leached cm^3	Permeability K cm/sec	# PV Leached
APR 6	15.5	55.3	3.1	16.8	8.0	3.04E-08	11.4
10	10.25	90.8	1.8	9.7	56.0	2.24E-07	11.6
11	8.17	21.9	2.4	12.8	8.0	1.01E-07	11.6
14	9.25	73.1	2.5	13.7	15.0	5.29E-08	11.7
15	13.33	28.1	2.8	15.0	9.0	7.57E-08	11.7
17	9.00	43.7	2.5	13.7	13.0	7.67E-08	11.8
18	14.33	29.3	3.1	16.5	9.0	6.57E-08	11.8
19	13.50	23.2	2.4	13.1	10.0	1.17E-07	11.8
20	14.00	24.5	3.5	18.7	13.5	1.04E-07	11.9
22	12.08	46.1	3.0	16.2	44.0	2.08E-07	12.1
24	10.00	45.9	3.1	16.8	65.0	2.97E-07	12.3
26	11.50	49.5	3.1	16.5	104.0	4.50E-07	12.7
28	8.42	44.9	2.8	15.3	54.0	2.78E-07	13.0
30	11.17	50.8	2.7	14.3	31.0	1.51E-07	13.1
MAY 1	13.37	26.2	2.9	15.6	15.0	1.30E-07	13.1
3	8.17	42.8	3.0	16.2	21.0	1.07E-07	13.2
4	14.20	30.0	3.2	17.5	19.0	1.28E-07	13.3
6	17.58	51.4	3.2	17.5	29.0	1.14E-07	13.4
8	16.50	46.9	2.9	15.6	24.0	1.16E-07	13.5

(Sheet 3 of 3)

Table D15

Ninth Avenue Permeameter Cell 15 Data

Date	Time	Time Increment hrs	Head ft H_2O	Hydraulic Gradient i	Volume Leached cm^3	Permeability K cm/sec	# PV Leached
OCT 28	14.25	0.0	1.6	8.7	0.0	Start-up	
29	14.92	24.7	2.9	15.6	77.0	7.08E-07	0.3
30	17.25	26.3	2.1	11.2	30.0	3.59E-07	0.4
31	13.42	20.2	2.6	14.0	13.0	1.62E-07	0.5
NOV 1	12.75	23.3	4.5	24.3	35.0	2.18E-07	0.6
2	13.17	24.4	4.4	24.0	17.0	1.03E-07	0.7
3	12.00	22.8	3.7	20.0	24.0	1.86E-07	0.8
4	12.67	24.7	3.6	19.3	38.0	2.82E-07	0.9
5	17.17	28.5	3.7	20.0	31.0	1.93E-07	1.1
6	17.50	24.3	4.2	22.4	16.0	1.04E-07	1.1
7	13.67	20.2	4.7	25.6	11.0	7.54E-08	1.2
8	13.25	23.6	4.2	22.4	28.0	1.87E-07	1.3
9	13.08	23.8	3.5	18.7	15.0	1.19E-07	1.3
10	11.25	22.2	3.2	17.5	10.0	9.14E-08	1.4
11	17.75	30.5	4.1	22.1	10.0	5.24E-08	1.4
12	17.17	23.4	4.3	23.1	15.0	9.82E-08	1.5
13	16.00	22.8	3.8	20.6	8.0	6.02E-08	1.5
14	11.92	19.9	4.1	22.1	13.5	1.08E-07	1.6
15	12.25	24.3	3.8	20.6	18.0	1.27E-07	1.6
16	13.50	25.3	3.6	19.3	19.0	1.38E-07	1.7
17	13.92	24.4	5.3	28.7	14.0	7.07E-08	1.8
18	13.67	23.8	4.7	25.6	24.0	1.40E-07	1.9
19	11.25	21.6	3.7	20.3	24.0	1.94E-07	2.0
20	14.50	27.3	3.7	20.0	25.0	1.63E-07	2.1
21	12.25	21.8	3.6	19.3	20.0	1.68E-07	2.1
22	13.75	25.5	3.5	18.7	22.0	1.63E-07	2.2
23	15.62	25.9	3.6	19.3	24.0	1.70E-07	2.3
25	15.50	47.9	3.6	19.3	47.0	1.80E-07	2.5
27	14.55	47.1	3.5	19.0	50.0	1.98E-07	2.7
28	11.17	20.6	3.5	18.7	21.5	1.97E-07	2.8
29	13.33	26.2	3.9	21.2	33.0	2.10E-07	2.9
DEC 1	12.25	22.9	3.7	20.0	22.0	1.70E-07	3.0
2	12.75	24.5	3.6	19.3	27.5	2.05E-07	3.1
4	18.30	53.6	3.7	20.0	61.0	2.02E-07	3.4
5	12.67	18.4	3.8	20.6	22.5	2.10E-07	3.5
6	13.33	24.7	3.8	20.6	29.0	2.02E-07	3.6
7	13.25	23.9	3.7	20.3	29.0	2.12E-07	3.7
8	13.50	24.3	3.8	20.6	27.0	1.91E-07	3.8
9	13.25	23.8	3.8	20.6	27.5	1.99E-07	3.9
10	14.08	24.8	4.3	23.1	28.0	1.73E-07	4.0
11	12.58	22.5	4.6	24.9	16.0	1.01E-07	4.1
12	8.25	19.7	4.4	23.7	40.0	3.03E-07	4.3

(Continued)

(Sheet 1 of 3)

Table D15 (Continued)

Date	Time	Time Increment hrs	Head ft H_2O	Hydraulic Gradient i	Volume Leached cm^3	Permeability K cm/sec	# PV Leached
DEC 14	13.42	53.2	2.8	15.3	68.0	2.96E-07	4.5
15	12.67	23.3	3.6	19.3	28.0	2.20E-07	4.6
16	8.40	19.7	3.9	21.2	22.5	1.90E-07	4.7
18	12.33	51.9	3.8	20.6	53.0	1.75E-07	4.9
19	13.50	25.2	2.7	14.7	32.0	3.07E-07	5.1
20	13.67	24.2	4.6	24.9	28.0	1.64E-07	5.2
21	13.25	23.6	3.4	18.4	39.0	3.18E-07	5.3
22	16.75	27.5	3.6	19.3	30.0	2.00E-07	5.5
24	10.08	41.3	3.7	20.0	55.0	2.36E-07	5.7
26	10.33	48.3	3.7	20.3	59.0	2.13E-07	5.9
27	12.25	25.9	3.7	20.3	35.0	2.36E-07	6.1
28	10.83	22.6	3.9	21.2	29.0	2.14E-07	6.2
29	13.83	27.0	3.9	21.2	35.0	2.16E-07	6.3
30	17.17	27.3	3.7	20.3	29.0	1.85E-07	6.4
31	11.92	18.8	3.6	19.3	20.0	1.95E-07	6.5
JAN 1	19.00	31.1	3.5	18.7	33.0	2.01E-07	6.6
3	15.58	44.6	3.9	21.2	51.5	1.93E-07	6.9
4	17.42	25.8	4.3	23.4	35.0	2.05E-07	7.0
5	15.67	22.3	4.2	22.4	29.0	2.05E-07	7.1
6	17.83	26.2	3.5	18.7	30.0	2.17E-07	7.2
8	11.92	42.1	3.9	21.2	47.0	1.86E-07	7.4
9	15.00	27.1	3.7	20.3	35.0	2.26E-07	7.6
10	15.58	24.6	3.5	19.0	27.0	2.04E-07	7.7
11	16.25	24.7	3.7	20.0	27.5	1.98E-07	7.8
13	16.58	48.3	3.9	21.2	58.0	2.00E-07	8.0
15	12.17	43.6	3.7	20.3	48.0	1.92E-07	8.2
17	14.58	50.4	3.7	20.0	56.0	1.97E-07	8.4
18	17.58	27.0	3.8	20.6	34.0	2.16E-07	8.6
FEB 10	17.17	29.9	4.4	23.7	42.0	2.09E-07	8.7
12	12.25	43.1	4.0	21.8	35.0	1.32E-07	8.9
13	10.42	22.2	4.2	22.4	20.0	1.42E-07	9.0
14	16.67	30.3	4.3	23.1	25.0	1.27E-07	9.1
16	9.17	40.5	4.0	21.8	29.0	1.16E-07	9.2
18	10.50	49.3	4.2	22.4	32.0	1.02E-07	9.3
20	10.08	47.6	3.1	16.5	28.0	1.26E-07	9.4
22	8.17	46.1	4.2	22.4	25.0	8.54E-08	9.5
23	8.17	24.0	4.0	21.8	13.0	8.78E-08	9.6
25	17.42	57.3	5.4	29.0	30.0	6.39E-08	9.7
27	9.08	39.7	5.2	28.1	18.0	5.72E-08	9.8
MAR 1	8.17	47.1	4.3	23.1	14.0	4.56E-08	9.8
3	11.33	51.2	4.6	24.9	14.0	3.88E-08	9.9
5	13.92	50.6	4.2	22.4	20.0	6.23E-08	9.9

(Continued)

(Sheet 2 of 3)

Table D15 (Concluded)

Date	Time	Time Increment hrs	Head ft H_2O	Hydraulic Gradient i	Volume Leached cm^3	Permeability K cm/sec	# PV Leached
MAR 6	10.50	20.6	4.2	22.4	8.5	6.51E-08	10.0
8	16.75	54.3	4.4	23.7	18.0	4.95E-08	10.1
9	16.42	23.7	4.2	22.4	9.0	5.99E-08	10.1
12	16.00	71.6	4.5	24.3	26.0	5.28E-08	10.2
15	11.00	67.0	4.0	21.8	26.0	6.29E-08	10.3
APR 20	14.00	23.5	4.6	24.9	12.0	7.24E-08	10.3
22	12.08	46.1	4.2	22.8	26.0	8.77E-08	10.4
24	10.00	45.9	4.2	22.8	21.0	7.11E-08	10.5
26	11.50	49.5	4.2	22.8	27.0	8.47E-08	10.6
28	8.42	44.9	4.0	21.5	23.0	8.42E-08	10.7
30	11.17	50.8	4.3	23.1	22.0	6.64E-08	10.8
MAY 1	13.37	26.2	4.4	23.7	12.0	6.84E-08	10.9
3	8.17	42.8	4.3	23.4	19.0	6.71E-08	10.9
4	14.20	30.0	4.3	23.1	13.0	6.63E-08	11.0
6	17.58	51.4	4.7	25.6	22.0	5.92E-08	11.1
8	16.50	46.9	5.0	26.8	21.0	5.90E-08	11.2

(Sheet 3 of 3)

Table D16

Ninth Avenue Permeameter Cell 16 Data

Date	Time	Time Increment hrs	Head ft H_2O	Hydraulic Gradient i	Volume Leached cm^3	Permeability K cm/sec	# PV Leached
OCT 28	14.25	0.0	1.6	8.7	0.0	Start-up	
29	14.92	24.7	2.9	15.6	19.0	1.75E-07	0.1
30	17.25	26.3	2.1	11.2	21.0	2.51E-07	0.2
31	13.42	20.2	2.6	14.0	15.0	1.87E-07	0.2
NOV 1	12.75	23.3	4.5	24.3	58.0	3.61E-07	0.5
2	13.17	24.4	4.4	24.0	62.0	3.74E-07	0.7
3	12.00	22.8	3.7	20.0	60.0	4.66E-07	0.9
4	12.67	24.7	3.6	19.3	49.0	3.63E-07	1.1
5	17.17	28.5	3.7	20.0	38.0	2.36E-07	1.3
6	17.50	24.3	4.2	22.4	22.0	1.42E-07	1.4
7	13.67	20.2	4.7	25.6	21.0	1.44E-07	1.5
8	13.25	23.6	4.2	22.4	48.0	3.21E-07	1.7
9	13.08	23.8	3.5	18.7	35.0	2.78E-07	1.8
10	11.25	22.2	3.2	17.5	28.0	2.56E-07	1.9
11	17.75	30.5	4.1	22.1	31.0	1.62E-07	2.0
12	17.17	23.4	4.3	23.1	30.0	1.96E-07	2.2
13	16.00	22.8	3.8	20.6	21.0	1.58E-07	2.2
14	11.92	19.9	4.1	22.1	19.0	1.52E-07	2.3
15	12.25	24.3	3.8	20.6	27.0	1.91E-07	2.4
16	13.50	25.3	3.6	19.3	24.5	1.77E-07	2.5
17	13.92	24.4	5.3	28.7	20.0	1.01E-07	2.6
18	13.67	23.8	4.7	25.6	23.0	1.34E-07	2.7
19	11.25	21.6	3.7	20.3	25.0	2.02E-07	2.8
20	14.50	27.3	3.7	20.0	24.0	1.56E-07	2.9
21	12.25	21.8	3.6	19.3	18.0	1.51E-07	3.0
22	13.75	25.5	3.5	18.7	19.0	1.41E-07	3.0
23	15.62	25.9	3.6	19.3	20.5	1.45E-07	3.1
25	15.50	47.9	3.6	19.3	35.0	1.34E-07	3.3
27	14.55	47.1	3.5	19.0	40.0	1.58E-07	3.4
28	11.17	20.6	3.5	18.7	18.0	1.65E-07	3.5
29	13.33	26.2	3.9	21.2	27.0	1.72E-07	3.6
30	11.25	21.9	3.6	19.6	22.0	1.81E-07	3.7
DEC 1	12.25	25.0	3.7	20.0	25.0	1.77E-07	3.8
2	12.75	24.5	3.6	19.3	25.0	1.87E-07	3.9
4	18.30	53.6	3.7	20.0	53.0	1.75E-07	4.1
5	12.67	18.4	3.8	20.6	19.0	1.78E-07	4.2
6	13.33	24.7	3.8	20.6	25.0	1.74E-07	4.3
7	13.25	23.9	3.7	20.3	24.0	1.75E-07	4.4
8	13.50	24.3	3.8	20.6	23.0	1.63E-07	4.5
9	13.25	23.8	3.8	20.6	25.0	1.81E-07	4.6
10	14.08	24.8	4.3	23.1	26.0	1.60E-07	4.7
11	12.58	22.5	4.6	24.9	27.0	1.39E-07	4.8

(Continued)

(Sheet 1 of 3)

Table D16 (Continued)

Date	Time	Time Increment hrs	Head ft H_2O	Hydraulic Gradient i	Volume Leached cm^3	Permeability K cm/sec	# PV Leached
DEC 12	8.25	19.7	4.4	23.7	50.0	3.79E-07	5.0
14	13.42	53.2	2.8	15.3	59.0	2.57E-07	5.2
15	12.67	23.3	3.6	19.3	23.0	1.81E-07	5.3
16	8.40	19.7	3.9	21.2	22.0	1.86E-07	5.4
18	12.33	51.9	3.8	20.6	45.0	1.49E-07	5.6
19	13.50	25.2	2.7	14.7	26.0	2.49E-07	5.7
20	13.67	24.2	4.6	24.9	23.0	1.35E-07	5.8
21	13.25	23.6	3.4	18.4	22.0	1.79E-07	5.8
22	16.75	27.5	3.6	19.3	26.0	1.73E-07	5.9
24	10.08	41.3	3.7	20.0	42.0	1.80E-07	6.1
26	10.33	48.3	3.7	20.3	46.0	1.66E-07	6.3
27	12.25	25.9	3.7	20.3	28.0	1.88E-07	6.4
28	10.83	22.6	3.9	21.2	23.0	1.70E-07	6.5
29	13.83	27.0	3.9	21.2	28.0	1.73E-07	6.6
30	17.17	27.3	3.7	20.3	28.0	1.79E-07	6.7
31	11.92	18.8	3.6	19.3	17.0	1.66E-07	6.8
JAN 1	19.00	31.1	3.5	18.7	28.0	1.70E-07	6.9
3	15.58	44.6	3.9	21.2	42.0	1.57E-07	7.1
4	17.42	25.8	4.3	23.4	22.0	1.29E-07	7.2
5	15.67	22.3	4.2	22.4	25.0	1.77E-07	7.3
6	17.83	26.2	3.5	18.7	24.0	1.73E-07	7.4
8	11.92	42.1	3.9	21.2	39.5	1.57E-07	7.5
9	15.00	27.1	3.7	20.3	28.0	1.80E-07	7.6
10	15.58	24.6	3.5	19.0	28.0	2.12E-07	7.7
11	16.25	24.7	3.7	20.0	24.0	1.72E-07	7.8
13	16.58	48.3	3.9	21.2	50.0	1.73E-07	8.0
15	12.17	43.6	3.7	20.3	40.0	1.60E-07	8.2
17	14.58	50.4	3.7	20.0	43.0	1.51E-07	8.4
18	17.58	27.0	3.8	20.6	23.0	1.46E-07	8.5
FEB 10	17.17	29.9	4.4	23.7	50.0	2.49E-07	8.7
12	12.25	43.1	4.0	21.8	45.0	1.69E-07	8.8
13	10.42	22.2	4.2	22.4	20.0	1.42E-07	8.9
14	16.67	30.3	4.3	23.1	29.0	1.47E-07	9.0
16	9.17	40.5	4.0	21.8	40.0	1.60E-07	9.2
18	10.50	49.3	4.2	22.4	43.0	1.37E-07	9.4
20	10.08	47.6	3.1	16.5	40.0	1.80E-07	9.5
22	8.17	46.1	4.2	22.4	35.0	1.20E-07	9.7
23	8.17	24.0	4.0	21.8	18.0	1.22E-07	9.7
25	17.42	57.3	5.4	29.0	48.0	1.02E-07	9.9
27	9.08	39.7	5.2	28.1	34.0	1.08E-07	10.1
APR 20	14.00	23.5	4.6	24.9	19.0	1.15E-07	10.2
22	12.08	46.1	4.2	22.8	38.0	1.28E-07	10.3

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(Sheet 2 of 3)

Table D16 (Concluded)

Date	Time	Time Increment hrs	Head ft H_2O	Hydraulic Gradient i	Volume Leached cm^3	Permeability K cm/sec	# PV Leached
APR 24	10.00	45.9	4.2	22.8	33.0	1.12E-07	10.4
26	11.50	49.5	4.2	22.8	40.0	1.26E-07	10.6
28	8.42	44.9	4.0	21.5	35.0	1.28E-07	10.7
30	11.17	50.8	4.3	23.1	36.0	1.09E-07	10.9
MAY 1	13.37	26.2	4.4	23.7	18.0	1.03E-07	11.0
3	8.17	42.8	4.3	23.4	28.0	9.89E-08	11.1
4	14.20	30.0	4.3	23.1	20.0	1.02E-07	11.1
6	17.58	51.4	4.7	25.6	31.0	8.34E-08	11.3
8	16.50	46.9	5.0	26.8	30.0	8.43E-08	11.4

(Sheet 3 of 3)